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NOTES

CHEMISTRY.

MATTER

AND IT'S FORMS

1/ Matter is that of which every sensible substance is a form.

2/ Matter & Body are nearly synonimous; - when op=
=posed to each other, Body signifies a part of Mat.
=ter - Body is likewise used for matter, as opposed to Spirit.

3/ Matter may conveniently be considered as existing un=
=der 4 forms or in 4 states. viz. 1st the solid; 2nd
the liquid; 3rd The gaseous or Aeriform, & 4th. The
Radiant.

4/ Gases are very attenuated like the air which we
breathe.

5/ Solids and liquids are much heavier than Gases.

6/ Vapour is the name given to any matter which
may be thin & gaseous like the air; differing how=
=ever from it, from being easily condensed into a li=
=quid as steam which becomes water, when exposed
to cold.

7/ Radiant Matter comprehends Light, Caloric, (The
principle of heat) & electricity; called "Radiant"
because the particles, whatever their nature may
be, seem to proceed in series called "Rays"

8/ All permanently elastic fluids, simple or com=
=pound, are called "Gases".

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9/ Sulphuric Æther is always a liquid in our climate; if exposed to the rigours of a polar winter, it would be=come solid; but if transported to the Torrid Zone it would become a permanently elastic gas.

Experiment.

Shewing how vapour may be condensed Without the application of cold.

Put a peice of dry phosphorus into a tin cup covered by a glass Jar, previously igniting it. The Phosphoric vapour combining with the oxygen of the included air forms a solid (Phosphoric Acid) which falls like flakes of snow, or adheres to the top of the jar.

Derivation & meaning of some words used in Chemistry

Attenuated from the Latin attenuo to make thin.
Condense. To bring the particles of a substance nearer.
condensation. The act of condensing.
Liquate To make liquid.
liquify. To become liquid.
liquifaction. The act of liquifying.
Matter deriv: fr: Lat: Materia which is der: from
ματηρ The Doric form of μητηρ.
Radiant der: from Radius. a ray.
Solidate To make solid
Solidify To become solid.
Solidification The act of solidifying
vaporize To turn into a thin vapour
vaporization. The act of vaporizing.

DSI

1/ A body which has resisted every attempt to resolve it-
into seperate and simple parts is termed <u>undecom-
pounded</u> & must in the present state of our knowlege
be regarded as an Experimental Element. Such a body
is also is often termed an element or simple body.
It is probable that the elementary bodies of Nature may
be very distinct from those which are called "elemen-
tary bodies". It is probable that the elements of
Nature may be dissimilar from those which we
call elements; it is not improbable that they are
altogether unknown, & that they are so recondite
as for ever to elude the sagacity of human search-
2/ ed <u>compound</u> body consists of different kinds of
matter which can be seperated from each other; as
salt-water, from which the water is seperated by
boiling, the salt being left.
3/ The elementary substances of which a body is composed,
are called its constituent parts. To decompose a body
is therefore to seperate its constituent parts.
4/ <u>Division</u> & <u>Decomposition</u> are different, if we divide a
body by pounding it to the finest powder, every the
minutest particle will still consist of a portion of the
several constituent parts of the whole body: These are
called its integrant parts
5/ The indivisible particles of which all masses of matter
are composed, are called <u>Atoms</u>.

Experiments.

Illustrative of the Divisibility of Matter.

1/ Dissolve a grain of Sulphate of iron, which contains about $\frac{1}{5}$th of Iron in a glass Jar full of water; & add to the solution two drops of a solution of Ferro-Prussiate of Potassa. Every portion of the water will be coloured by the Ferro-Prussiate, one of its ingredients, acting on the Iron.

2/ Dissolve a grain of Sulphate of iron in a quart of water, & pour a few drops of the solution into a wine glass full of water to which a few drops of tincture of Galls have been added. The dilute infusion of Galls will soon become of a purplish hue: this shows that every drop of the quart of water in which the Sulphate of iron was dissolved contains a notable portion of it.

NB Galls are protuberances made by insects in the oak: the best are thus brought from Aleppo.

1/ Attraction is that property by which masses or particles of Matter tend towards each other. Its opposite is repulsion.

2/ The various kinds of Attraction may be arranged under this class. viz.

- Class I (acting at sensible distances)
  - 1: Attr. of Gravitation
  - 2 Electrical attrac
    - 1 Voltaic Electricity
    - 2 common . . . .
    - 3 magnetic . . . . .
- Class II (acting at insensible distances)
  - 1: Attr. of Aggregation or Cohesion.
    - Capillary attraction
  - 2: Attr of Composition or Chemical affinity.

NB. Magnetic Electricity is that exhibited by a magnet; Chemical ~~affinity~~ is that which is caused by chemical action. Common electricity is that which is excited by mechanical action.

Experiments.

Illustrative of the distinction between the different kinds of Attraction.

I (Gravitation). Let two peices of cork, differing in size be placed at some distance from each other upon the smooth surface of water in a basin. They will move toward each other with increasing velocity, (the lesser the more rapidly) adhere, & then approach, in conjunction, with the side of the basin, where, being equally attracted by the surrounding bodies, they will remain at rest.

II (Electrical Attraction). Rub a peice of Amber briskly upon a peice of dry cloth, & immediately hold it at a small distance from a light feather: it will attract the feather. This is an instance of common electricity.

III (Cohesion, strictly so called). Put two plates of glass together, interposing water or any other liquid, to fill up the pores in their surfaces, & prevent the lodgement of air: they will cohere with considerable force. - (2 Capillary attraction) Let a glass tube, open at both ends having a very small bore, be immersed in a vason of water; the water will mount up in the tube, higher than its level in the vason.

IV (The attraction of composition or chemical affinity). Put a some drops of a solution of muriate of lime (a compound of muriatic acid & lime) into one glass, & the same quantity of sulphuric acid, diluted with water, into another. Put the latter liquid suddenly into the former instantly

a solid will be produced, namely, Sulphate of lime (commonly called Gypsum or Plaister of Paris). The sulphuric acid having a greater attraction or affinity for the Lime than the Muriatic acid, it unites with the lime of the Muriatic, and the muriatic acid is set free. A new compound is formed, Sulphate of lime, — hence the term, the attraction of composition.

I The Attraction of Gravitation.

1/ Gravitation or Gravity, is that Attraction which exists between Masses of Matter; or that power by which Distant bodies have a tendency to approach each other. It acts at sensible distances.

2/ Weight and Gravity are nearly synonimous; for, as Gravity acts in proportion to the quantity of matter in a body, without any regard either to its bulk or figure — it therefore, constitutes its weight. — Thus, Weight may be said to be the Measure of Gravity.

3/ All terrestrial bodies tend toward the centre of the earth Globe, where the force of Gravity is, as it were, accumulated, and, Consequently, fall every where perpendicular to its surface, unless deflected by the powerful gravity of some mass of Matter.

NB: Mount Schehallion in Perthshire has been found to deflect the ball of a plummet about 6".

4/ The Magnitude of a body is its bulk; The Mass of a body is the sum of its material atoms; the quantity of Matter in all bodies is in the ratio of their Magnitudes and densities.

5/ The force of Gravity is directly as the mass or quantity of matter. Whence, the power of Gravity in one body exceeds that in another, by how much the former body exceeds the other in weight.

6/ In all situations equidistant from the centre of the earth, the force of Gravity is equal. As the earth's equatorial dia-

=meter is longer than its polar by 34 miles. - The force of gravity must act more powerfully at the poles than at the equator. This is shown by the acceleration of the vibrations of a pendulum in the polar regions. Hence, a clock, constructed for our latitude, would, when conveyed nearer the North pole, accelerate, as it were, the flight of time - whereas when carried near the Equator, it would retard it.

3/ The force of gravity is greatest at the surface of the earth, whence it diminishes upwards and downwards. The gravitating force of a body is least at the earth's centre, because, there, it is equally surrounded by an attracting

4/ It is Gravitation, under certain restrictions, that governs the Planets in their orbits, & causes them to revolve round the sun within a certain period.

5/ Attraction is to be viewed as a fact or phenomenon, succeeding some cause not yet discovered.

6/ For the discovery of this universal principle, and the development of its laws, we are indebted to the genius of the illustrious Newton.

Experiments

Illustrating the Attraction of Gravitation.

I The experiment of the corks, previously described, shows the effect of the Gravitation of smaller bodies - not generally observable on account of the superior attraction of the earth.

II If an half-crown piece & a slip of paper, of the same size & shape, be let fall separately, from the same height, at the same instant; the half crown piece will reach the ground a considerable time before the slip of paper: but, if the latter be placed above the former, they will both descend in nearly equal times. In the latter case, the coin pushes, as it were, the way for the paper, by overcoming the resistance of the air - From this simple experiment, we may infer that there is no such thing as positive gravity.

Attraction.

1/ The attractions dependant on electricity, in its various forms operate at sensible distances, & so far coincide with gravity.

2/ Cohesion or the attraction of Aggregation is that force by which particles of the same kind of matter are united. or that which is exerted between the integrant particles of a body. The only effect of this attraction is an aggregate or mass.

2/ Acts only at insensible distances.

3/ It is owing to the exertion of this force that all bodies manifest a resistance to divulsion & separate: this resistance is more or less obstinate according to the degree of vigour with which the attraction operates.

4/ The force of cohesion is different among different bodies. this attraction is most forcibly exerted in solids; & in them its power is estimated by the mechanical force necessary for effecting their division. In liquid bodies cohesion operates with far less energy; that it exists in gases or airs we have no evidence whatever. The power of cohesion is different in various states of the same body; for example the cohesion of water in the form of ice is considerable, in the form of a liquid it is much lessened & in the form of vapour it entirely disappears.

5/ Cohesion of solids. (A) If a small portion of the surface of two leaden bullets be pared clean & if they were then placed together with a slight twist, they will adhere so firmly as to require some force to pull them asunder. (B) If the surfaces of two polished plates of brass; or of glass be put together by rubbing the one upon the other, with a little oil between them, they will cohere with such force, as to require more than the weight of the lower plate to separate them. These two simple experiments show the cohesive force which exists between the particles of solid bodies.

6/ A body is solid when its component atoms touch each other

in surfaces; & bodies are enabled to do so by their regular crys-
-tallized forms. Thus, crystallization more or less perfect
is necessary toward solidity.

7/ Bodies owe their hardness, softness, tenacity, (viscosity
or glutinousness) ductility, & malleability to the different
figures of their component particles, & the greater or less
degree of cohesion consequent thereupon. Soft substances,
which are capable of being extended, are called viscous
or tenacious; harder substances, which have the same pro-
-perty are called ductile; & metals, which can be beaten out
are called malleable. In the malleable metals, the particles,
by hammering may be made to pass over each other; as
in lead.

8/ The cohesive force of the principle metals has been ascer-
-tained by a course of experiments, in which the weight
sustainable by a piece of each metal, one tenth of an
inch in diameter, were estimated: the weights were
found to be as follows;

Metals	lbs
Gold	500
Iron	450
Silver	370
Brass	360
Copper	299
Tin	49
Lead	29

9/ (Cohesion of liquids) The weak cohesion of liquids effects
an easy mobility of their particles amongst each other.
Water is constituted of small spherical atoms, & spheres
can touch each other only in points; hence the weak
cohesion of water. But that water is possessed of a degree of
cohesion is evinced by the spheroidal form which its drops
assume. A drop of water, whilst upon a table, assumes
the form of an elongated spheroid, owing to the action of
Gravity. The greatest height at which a drop of water
will stand, is one fifth of an inch. A drop of rain, in
ordinary circumstances, is from the eighth to the tenth
of an inch in diameter.

10/ Water may be heaped up to a sensible height above the brim of a drinking glass or any other vessel; this experiment evinces its cohesive force. The water is enabled to rise up, in a convex form, above the brim of the vessel, by the cohesive force existing between its particles. This property is common to all liquids.

11/ If two globules of mercury be placed near each other, they will attract mutually & become one large drop. Mercury has a greater degree of cohesion for its own particles than water; & water has a greater degree of affinity for other particles than mercury

12/ (Cohesion of solids & liquids) There is a cohesive attraction between water & glass, which is proportional to the quantity of surface in contact. If a plate of clean glass be immersed in water, it will be found, on being taken out, that a film of water attaches itself to its surface which dilates in purly drops from its margin.

13/ Mercury has a strong attraction for clean glass. In the barometer mercury is apt to attach itself to the top of the tube from which it is necessary that it should be detached.

14/ The cohesive force between two glass plates is the greater the less the quantity of water between them.

15/ The upper surface of a film of water, overspreading the superficies of a glass plate is convex.

16/ (Capillary attraction) It is a remarkable fact that water rises higher in glass tubes of a narrower bore than in wider.

17/ The cause of this Phenomenon has been termed capillary attraction from capillaries. The effect being greatest when the bore of the tube is so very small as not to admit a fine hair.

18/ The usual diameters of capillary attraction are from the 10th to the 20th of an inch in diameter.

19th Capillary attraction, is, probably, a variety of the attraction of cohesion.

2/ *The Crystallization of Cohesion.* The Crystallization of Cohesion is exhibited in a great variety of substances: for example, if sugar is dissolved in a vessel containing boiling water, till the water can hold no more in solution; while the water cools the attraction of cohesion will be so forced between the particles of the sugar, will thus become the solid form.

CRYSTALLIZATION.

1/ When the particles of a body, in passing to the solid form the liquid or vaporform state, arrange themselves in a certain order, & form a solid of a regular symmetrical shape, this process is called Crystallization, & the result a Crystal.

2/ Bodies, whether solid, fluid, or vaporous, are susceptible of assuming the crystalline form; & the substances termed so are numerous.

3/ All bodies cannot be made to assume the same form by Crystallization; & the same body does not invariably exhibit the same form of Crystals, there may be several forms of crystals belonging to one - yet, in one or other of these it is true to crystallize & not according to any other form. With respect to crystals produced in the laboratory, it is true, in general, that the same body always concretes in the same, or at least, in a connected crystalline form; & on this uniformity of figure, one of the fundamental principles in distinguishing different kinds of matter depends. It may then, be taken as generally true, that we cannot distinguish one kind of body from another by its crystalline structure.

4/ That, in nature, the same substance crystallizes in forms apparently very dissimilar, take, for example, bi-sulphuret of Iron (martial pyrites) which produces, sometimes in cubes, sometimes regular octohedrons, at one time, dodecahedrons with pentagonal faces, & at another, Icosahedrons with triangular faces.

5/ Very different kinds of matter may crystallize after the same model, thus, fluate of lime, muriate of soda, bi-sulphuret of Iron, sulphuret of lead, etc crystallize in cubes under certain circumstances; & in other cases, the same minerals assume the form of a regular octohedron.

6/ Perfect mobility among the corpuscles is essential to crystallization. The Chemist produces this either 1st by ignition i.e. by melting solids or converting them into vapour, by the application of heat, — allowing them to return slowly to the solid form; or 2nd by solution in a liquid in which they are gradually deposited. When the temperature is slowly lowered in the former case, or the liquid slowly abstracted by evaporation in the latter, the cohesive force resumes the ascendency, arranging the particles in symetrical form.

7/ A solution which holds as much of any body as boiling water is capable of dissolving, is called a saturated solution.

8/ With few exceptions, all bodies are more soluble in hot than in cold water; so that as a hot saturated solution cools, it gradually lets fall that portion of the dissolved body, which the water, when cold, is incapable of holding in solution.

Note. Solvent, 'that which can dissolve'.

9/ A solution when not saturated, can be made to deposite crystals, by reducing it to a state of saturation: and this is done by evaporation, only getting rid of a portion of the solution by the application of heat.

10/ A pellicide, formed on the top of a solution, shows that it is in a fit state to deposide crystals on cooling.

11/ The whole of the substance in solution is not deposited in crystals, when cold. The cold solution is also a saturated solution, & is called the <u>mother-liquor</u>.

12/ The mother liquor will, by evaporation, yield another crop of crystals.

13/ Light affects crystallization: on examining bottles that have long contained camphor in druggist's shops, it will be found that the interior surface of the bottles which has been next the light is covered with crystals of camphor, while the side turned from the light is free from crystals.

14/ Some bodies carry down water with them as they crystallize: & this water, which becomes incorporated with them in a solid state is called - <u>The water of crystallization</u>.

15/ The water of crystallization differs in quantity, in the crystals of different bodies: but, it is always in the same quantity in the crystals of the same body: and, hence, we conclude that it is chemically combined.

16/ Those crystals, which contain water of crystallization are known by undergoing what is called <u>Watery fusion</u>, when exposed to heat: and, in this case, the crystallized body, if soluble, becomes dissolved in its own water of crystallization. This may be exemplified by holding over the fire a shovel containing crystals of alum.

17/ Some crystals, which do not contain water, undergo fusion - for instance Chlorate of Potassa: but, this fusion is termed the <u>dry fusion</u>, - because the substance subjected to it contains no water

18/ Though the crystals of some bodies are devoid of crys-

tallization, they may yet contain water, which be-
comes mechanically enclosed, in various proportions
as the crystallization proceeds - Crystals of this kind
are thus known: - when heated, the water within
them expands, & they decrepitate, or burst with a
crackling noise; but, they do not undergo the watery
fusion.

1/ Crystals, which preserve their form, when exposed
to the air, are called permanent crystals.

2/ Crystals, which lose their form and become liquid
when exposed to the air (by attracting water, which
~~is~~ it is always present in the atmosphere.)
are called deliquescent; for example Carbonate of
Potassa.

3/ When crystals lose their forms & fall into pow-
der on being exposed to the air, (in consequence
of parting with their water of crystallization)
they are called efflorescent.

The operation of crystallizing or crystallization
is of great utility in the purification of various
saline substances.

That science, which expounds the laws of crys-
tallization, & describes the various kinds, & forms
of crystals, is called crystallography.

Experiments in Crystallization.

1. Put alum into 8 or 10 ounces of water at a boiling
heat, in a glass or earthern vessel, adding it so long as
it is dissolved. In this saturated solution suspend a piece
of cinder, or a basket formed of wire or twine: on these
a crop of crystals more or less regular in their form,
will be deposited in a beautiful manner. Sulphate
of Copper &c. may be substituted for alum.
2. Expose a solution of Oxalic acid or Glauber's salt to the
air for some days, in a shallow dish; as the water

slowly evaporates, crystals appear.

III Boil water in a glass flask or iron goblet, and add sulphate of soda so long as any is dissolved: pour the solution into a phial which it completely fills and cork it tightly. no crystallization ensues when it is cold; but if the cork be then removed, crystallization immediately commences. If the air be not excluded as the solution in the phial cools, it crystallizes in the usual manner. This experiment shews that air influences crystallization.

IV Heat a tinned iron plate over the fire, till it is as warm as may be necessary to cause, water, dropped on it to evaporate quickly, with a slight hissing noise. Let the tin, with which the iron is coated, be then washed with a cloth, well moistened with a mixture composed of water 1oz. Muriatic acid one drachm, & nitric acid, 1dr. The cold fluid causes the hot tin suddenly to assume a crystalline form; and as the acids act on the external parts of the tin and expose those below, the crystalline arrangement is beautifully seen. When varnished, it retains its lustre: the varnish may be coloured of any tint that may be required. Tea canisters, &c. are embellished in this way.

V The crystals of metals may be obtained by fusing them in a crucible with a hole in its bottom closed by a stopper, which is to be drawn out after the vessel has been removed from the fire, & the surface of the metal has begun to congeal. The same effect may be observed if the metal be poured into a plate or dish, a little inclined, which is to be suddenly inclined in the opposite direction, as soon as the metal begins to congeal round its edges. In the former method, the fluid part of the metal runs out of the hole, leaving a kind of cup lined with crystals: in the latter, the superior part, which is fluid, runs off, leaves a plate of metal studded over with crystals.

VI Put a little Benzoic acid or Camphor on a piece of Tin; and invert over it a glass tumbler containing a sprig of Rosemary or Lavender, then, apply a moderate heat under the tin — and the acid or camphor will volatilize, in a beautiful crystalline form, on the inside of the sides of the glass. This is an example of crystallization from the aëriform state.

VII Crystallize, on glass slips, held over a lamp flame, — re-
moving the slip from the heat. the moment any Solid
appears on the edges — Sulphate of Soda, Oxalic acid,
Muriate of Morphia, & Bichloride of Mercury: observe
the crystals through a microscope.

VIII Hold 200 grains of Sulphur cautiously in a flask; re-
move the heat, & pour out half the liquid when the other
has consolidated: then observe the crystals of Sulphur.

1/ Chemical affinity or attraction is that power which
combines the constituent particles of a body.

2/ The difference between chemical affinity & cohesion may
be thus stated: — Cohesion unites only particles of a
similar nature, — chemical affinity combines part-
-icles of a dissimilar nature. Cohesion does not change
the properties of the particles of which it is formed, —
Chemical affinity, on the contrary, produces com-
-pound bodies quite different from any of their cons-
-tituents. A mass of marble consists of a vast num-
-ber of particles, all of which are of the same na-
-ture as the whole mass, these are held together
by the attraction of aggregation or cohesion; but the
lime & carbonic acid, of which these particles, as
well as the mass itself, is composed, are united
by chemical affinity.

3/ It is by this power that composition and decom-
-position are effected. The general name for the
result of chemical affinity is a compound — the sub-
-stances of which it is composed being called its com-
-ponents or constituent parts or principles. The sepa-
-ration of these is termed decomposition; & when de compo-
-sition is performed for the purpose of ascertaining the

The composition of a body, it is named Chemical Analysis. The reunion of the constituent parts is denominated Chemical Synthesis.

4/ The constituent particles are the most minute parts, in to which a compound body can be resolved by decomposition; & hence they are of a different nature, both with regard to each other & the substance itself to which their mutual union gives rise. The integrant particles are the most minute parts into which any body can be resolved without decomposition. The constituent parts of a body cannot be seperated by mechanical means, which seperate only the integral particles.

5/ All Chemical actions consists in composition and decomposition, & change of properties is the characteristic feature of Chemical action; Solids often become liquid or gaseous; liquids again frequently become gaseous or solid; and gases may be changed into solids or liquids; - while heat & light are often evolved as these new arrangements take place.

6/ Chemical affinity can take place between 2, 3, or even a greater number of bodies.

7/ The force of Chemical affinity between the constituents of a body, is estimated by that which is requisite for their separation.

1/ Bodies have a tendency to unite with some substances in preference to others; no one body has not the same degree of affinity towards several others, but attracts them unequally.

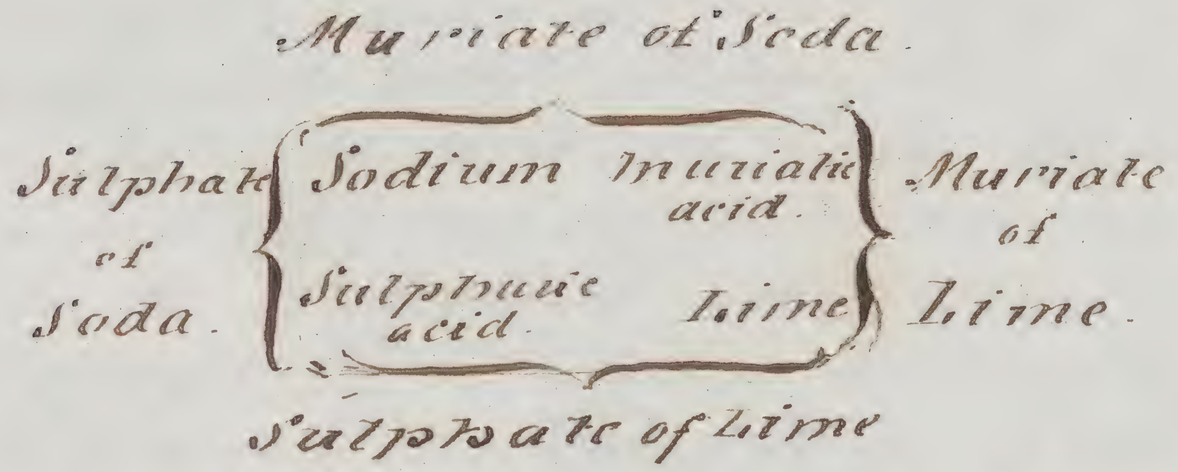
(Experiments) - Pour dilute muriatic acid on a piece of marble; which is composed of Carbonic acid & lime; the lime quitting the carbonic acid, combines with the muriatic acid, the carbonic acid being expelled in a gaseous state. A new compound, muriate of lime, is thus formed in solu-

=tion, — on adding to which sulphuric acid, the lime will attract that acid in preference to the muriatic, & sulphate of lime will be formed precipitated - the muriatic acid being liberated.
Thus, it is known that, of the 3 acids, (carbonic, muriatic, sul=phuric) lime has the greatest affinity for the sulphuric, the least for the carbonic. —
This fact on which the whole science of Chemistry is based, may be, generally, illustrated thus:
Let A and B represent the constituents of a body:
If we present to this body another substance i, which has a greater affinity for B than A has, — it follows that B will leave A to combine with i.
Thus the original body AB has been decomposed by i; A has been left alone, or liberated, & a new compound, Bi has been formed. —

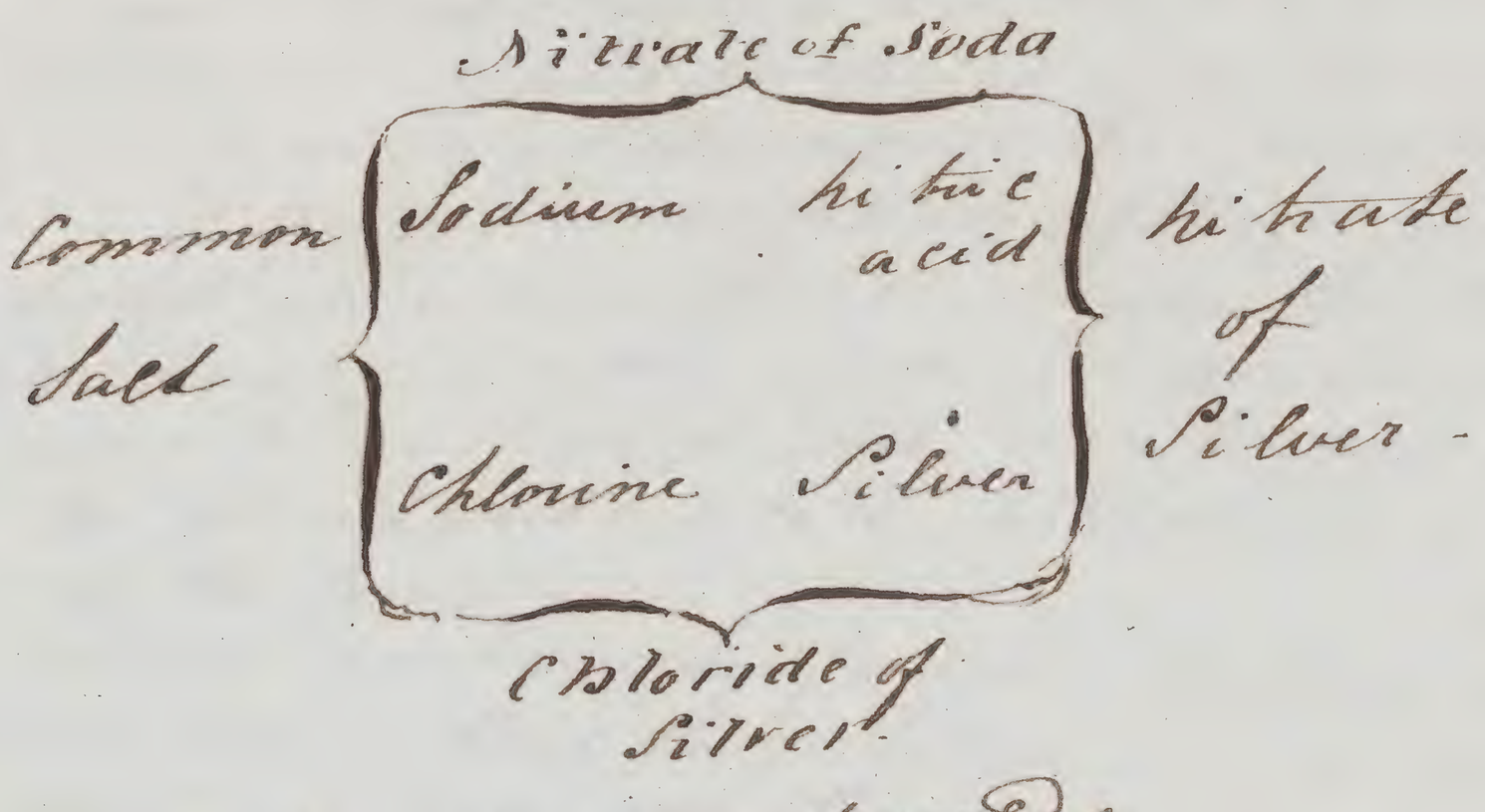
2/ The preference or election, which any given body is found to exercise in uniting with other substances, is metaphorically termed <u>Elective affinity</u>.

3/ Elective affinity is of two kinds, each of which derives its appellation from the number of principles brought in to contact with each other. — When (as in the last experiment) on presenting a simple to a compound substance, the former unites with one of the constituents of the latter, so as to separate it from that with which it is combined, the decomposition thus produced, is said to be effected by <u>single</u> or <u>simple</u> elective affinity: otherwise single (or simple elective affinity is that by which one compound is decomposed, & one new compound formed.

4/ (<u>Experiment</u>) - Add a solution of sulphate of soda, (a compound consisting of sulphuric acid and soda) to a solution of muriate of lime (a compound consisting of Muriatic acid and lime): the sulphuric acid of the sulphate will unite with the lime of the muriate, & form sulphate of lime, which will be precipitated, - while the muriatic of the muriate will unite with the soda of the sulphate, & form form muriate of soda in solution. — These changes may be more clearly understood by the following diagram. —



the following diagram exhibits an example of the same kind.



however unlike two compounds,
how when two compounds mutually act on each other, & produce, by interchange of affinities two new compounds, the attraction, in this case, is called double or electric affinity. Otherwise: when two principles are presented to a compound body, & when they unite, each with one of those of the compound, two new substances are formed, and all instances of decomposition and composition in this manner are said to be effected by double or complex electric affinity.

5/ Some substances cannot be decomposed by single electric affinity.

6/ All changes effected by complex electric affinity are permanent, and the new compounds thus formed, cannot be decomposed, until a

a substance, having a more powerful attraction for one of its constituents than they have for each other is brought into contact with them.

// There are various circumstances which modify the effects of elective attraction. The chief of these is the temperature, which, acting on the several parts of compounded bodies seldom fails to alter, and frequently reverses the effects of the affinities. (Experiment.) - If sulphuric acid be added, in a common temperature, to a combination of phosphoric acid and lime, it will decompose this combination, & disengage the phosphoric acid. but, if the same mixture of these principles be exposed, to a considerable heat, the sulphuric acid will have its attraction to the lime so much diminished, that it will rise to give place, again, to the phosphoric acid, which will combine with the lime.

Numberless instances of a like nature establish the conclusion - that the elective attractions are not constant, but at one the same heat.

// 1. Bodies combine in definite proportions. Bodies consist of atoms incapable of further diminution or division, - probably spherical: it is these ultimate particles that unite in chemical combinations.

2. If mercury be agitated for some time in the open air, the surface will become covered with a black, insipid, insoluble powder; and, this effect or new substance being the result of the combina-

-tion of the metal with oxygen (one of the gases, of which the atmosphere is composed) it is called an oxide. Now, it is found to consist of 200 parts of mercury & 8 of oxygen — again, if mercury be subjected to a considerable degree of heat, it will be converted into a red shining mass, which is, also, a compound of the metal with oxygen: but in the latter case, 16 parts of oxygen have united with 200 of the metal. Innumerable instances of the same kind might be adduced, but these are sufficient to prove the remarkable truth that, when different substances combine, the proportions of the ingredients are always uniform — that for every atom present of the substance, there is exactly one, two, or three &c of the other. — Thus, if there be 10 atoms of one substance, there are exactly 10 or 20, &c of the others, but never intermediate numbers as 13 or 23 to 10: for, then, a particle of the compound would consist of one atom of the first, & of $1\frac{3}{10}$ or $2\frac{3}{10}$ &c of the second substance — which is absurd, — as atoms are considered indivisible.

3) This fundamental truth — that the bodies, which unite chemically, tend to combine in certain fixed or definite proportions may be more clearly elucidated by the following example.

	Nitrogen		Oxygen		Total
Oxide of Nitrogen	14	+	8	=	22
Binoxide of Nitrogen	14	+	16	=	30
Hyponitrous acid	14	+	24	=	38
Nitrous acid	14	+	32	=	46
Nitric acid	14	+	40	=	54
Atmospheric acid	28	+	8	=	36.

Hence it appears, that when bodies unite in more than one proportion, the proportion in each successive compound is represented by a multiple of that of the compound — as the proportion in which the nitrogen combines is 14 & does not vary as the oxygen, it is regarded as the base of these compounds.

4. The equivalents of compounds are found by adding the equivalents of the elements; thus, 22 is the equivalent of oxide of nitrogen of 8 oxygen & 14 Hydrogen.

5. Scales have been formed to exhibit the equivalent ratios or combining proportions of chemical bodies. — The numbers representing these proportions, are termed chemical equivalents. It is evident that some body or must be fixed on & expressed by unity. Hydrogen gas, as the lightest known body in nature, & combining in the smallest proportions

by weight with the other simple bodies, has been taken as a standard of comparison for the combining proportions or equivalent numbers of all other bodies, — which, in all likelihood, are simple multiples of its number.

6) Oxygen has also, by some chemists, been taken as the standard of comparison & represented by 10. Those who take oxygen as the standard & represent it by 10, make the equivalent for oxygen 1.25; the result is, of course the same for the proportion of 1.25 to 10. being exactly the same as 1 to 8.

7) The union of gases is always effected in simple proportions of their volumes; i.e. a volume of one gas combines with an equal or twice or thrice the volume of another gas, and in no intermediate proportions.

NB. "volume" in chemistry, is employed to denote any quantity of a substance, in bulk. It is usually applied to the gases. Thus, if one volume of Hydrogen gas is a cubic foot, yard or any other quantity, — then two volumes are, of course, just double the cubic foot, yard or whatever the quantity was previously mentioned. The terms "atom" & "atomic weight" mean the least proportion by weight in which any body enters into combination with other bodies: "atom or atomic weight" is therefore, synonimous with "definite or combining proportion."

8) It is impossible to make water in any other proportion than 1 of oxygen to 2 of hydrogen, by weight — because 1 part of oxygen will require 2 parts of hydrogen to saturate it, & 2 parts of hydrogen will require 16 parts of oxygen to saturate it. Thus, if 1 part of oxygen only will combine with one part of hydrogen, forming water, — and that 2 parts of hydrogen will remain in its pure state. We may indeed add bodies together in what proportion we please; but they will combine chemically only in such proportions as are common to each.

9) Some bodies have the power of uniting in all proportions. Sulphuric acid & water, nitric acid & water, alcohol & water, unite in all proportions; & most salts in solution in water, will, also, combine with any additional quantity of water. The term "salt" denotes a compound in definite proportions, of acid matter with an alkali, earth, or metallic oxide.

10) Some bodies unite in all proportions only as far as a certain point; thus water will dissolve any quantity

of common salt- less than that which it is capable of hol-
=ding in solution when fully saturated. At the point in
question, all further combinations of salt with water ce-
=ase, in consequence of the alteration, which, then, subs-
=ists between the particles of salt & those of water - or, in
other words, the force of cohesive attraction then becom-
=es superior to that of chemical ~~action~~ attraction or affi-
=nity. There are, then, only three orders of combination.

I. That in which bodies unite in definite proportions
or multiples of proportions.

II. That in which bodies unite in all proportions

III. That in which bodies unite in all proportions up
to a certain limit.

The first of these orders of combination is characterized
by some remarkable change taking place; but, in the
last two orders of combination there is nothing thi-
=s - if we except the change of temperature, which
more or less varies the combination.

12/ Dr Dalton, is the author of the atomic theory; to
him we are indebted for the first development of
& demonstration of the fact - "That bodies unite in
definite proportions".

13/ The doctrine of definite proportions is extremely simple,
and it is of the greatest practical utility; for, it is
the base on which chemistry rests as a science. — If thrown
open the book of nature and shows us, that the minutest
substance on which we tread, as well as the most won-
-derful productions of the creation is formed by the union
of certain ingredients in proportions, which were never
known to vary.

Experiments illustrative

of Chemical Affinity.

1/ The attraction of Cohesion be overcome with ease, as occurs
in mechanical mixtures, when the particles of the
two bodies, the mixed of which is a new substance,
possessing powers entirely different from either of the
constituents in a different state. The new body thus

NB

= ces can act chemically with each other which are not mixed together in the most intimate manner - By heat, light, Electricity many kinds of chemical action may be effected which do not take place by mere mixture.

2. Shake sand and water in a bottle. Whenever the agi= =tation ceases the sand falls. — The water has no chemi= =cal action with it.

3. Suspend a piece of aqueous sulphate of copper by a thread in a glass full of water. The particles of both combine and form a stream of blue fluid which descends from the points where they are in contact. — The solid is said to be dissolved. The compound is called a solution of the solid.

4. Put a piece of an Iron hoop a few inches in length in= =to any glass vessel - Cover it with water & pour upon it aqueous sulphuric acid equal to one sixth of the bulk of water employed, so powerful will be the che= =mical action excited, that the particles of iron will be torn from each other & will combine with particles of the acid and of oxygen from the water - Hydrogen, the other element of water will be disengaged in a gaseous form -

5. Cover a piece of copper, contained in a glass, with Nitric acid: every particle of the copper will combine with a particle of acid, and together they will form a new body to= =tally different from either the copper or the acid - for the liquid, thus formed, is neither colourless nor sour like the acid, nor hard, heavy, & yellow like the copper. A composition attends the chemical action

the acid having overcome the resistance offered to it by the cohesion of the particles of copper; and, also, the weight of the copper - The copper is thus reduced to more minute particles than could a result from the exertion of any mechanical power. Where the union between the acid & the copper is complete, and the water, without the acid is diluted, is evaporated - the compound will assume the form of regular transparent crystals of a fine, blue colour. This is an example of Chemical composition - the compound being called "nitrate of copper". in the last experiment a piece of iron for which the acid has a stronger attraction than for copper, the acid will, now, quit - the copper to combine with the iron, & the copper will be precipitated - i.e. it will fall down in a seperate state appearing in its simple form. This is an instance of "Chemical Decomposition."

// Put some carbonate of soda into a glass, cover it with water & pour upon it aqueous sulphuric acid as long as gas escapes. Here, the chemical action, consists in the union of the particles of the sulphuric acid and those of the soda & carbonic acid the other ingredient in the carbonate of soda being expelled with effervescence. This term - Effervescence - is applied whenever gas escapes rapidly from any liquid.

ELEMENTS OF WHICH THE GLOBE IS COMPOSED

CHEMICAL EQUIVALENTS & SYMBOLS

The following article composes the names of the elements of which the globe is composed, according to the extent of man's present knowledge.— Before each is placed the symbol by which it is represented, and after it the chemical equivalent or quantity which the symbol indicates— Hydrogen being taken as a standard of comparison, the equivalent number of each element is ascertained by examining that quantity of it which combines with a given quantity of Hydrogen. Thus 8 parts of oxy: combine with 1 of Hydrogen &, therefore is the equivalent of Oxygen. Hydrogen being 1. But if any substance does not combine with Hydrogen, then its equivalent is ascertained by finding in what quantity it combines with the equivalent quantity of any other substance, which can unite with Hydrogen. For instance silver does not combine with Hydrogen but 110 of silver combines with 8 of oxygen. Therefore 110 is the equivalent number of silver; for that quantity of silver combines with 8 of oxygen, which again unites with 1 of Hydrogen.

H	Hydrogen	1.
C	Carbon	6
O	Oxygen	8
B	Boron	8
N	Nitrogen	14
S	Sulphur	16
P	Phosphorus	16.

* F
CL
* SE
* BR
I
SI
L
AL
MG
* G
GA
NA
GO
NT
FE
MN
GR
* IR
GU
* TT
* TE
* Y
Z
AS
ZIr
K
SK
SB
* K
* MO
* Ce
* Cd
* Pd
Sn
* Th
BoD
BI
* U

* Pt
Pb
Ag
Ta
Hg
Au
* Il
* Os
* V
* Pl

Caloric

The principal effects of heat are:
1. Expansion. 2 liquefaction. 3 vaporization.
4 Evaporation 5 Ignition.

1). Expansion

Air, expands in heat from 32° to 212° $\frac{3}{8}$ of its volume
Alcahol . . . . . $\frac{1}{9}$ . . . . .
Water . . . . . $\frac{1}{22}$ . . . . .
Hammered Iron . . . . . $\frac{1}{273}$ . . . . .

That air expands, is proved by inserting a bottle over water, and pouring boiling water over the bottom; bubbles of air escape.
That alcahol expands, is proved by the fact that a bladder containing a few drops of alcohol, becomes turgid when put into a basin of boiling water.
That water expands is proved by the water thermometer
The "Cabinet des arts et des Metiers" in Paris was preserved by the expansion & contraction of iron rods that were heated by Spirit-lamps. — Coach wheels are traced by the contraction of the tire, which is placed upon it when red hot. The expansion & contraction of metals is also manifest in the pendulum clock, which goes quicker in winter & slower in summer.—
Exceptions The maximum density of water is 40°: above & below this temperature it expands. at 32° water is frozen, and as the spicules of ice arrange themselves at a determinate angle, they necessarily occupy more space, than when the water is in a fluid state.
Antimony Bismuth & Lead & many other salts expand on cooling. This is caused by the particles assuming

a crystalline arrangement. A leaden bullet turns upon the surface of molten lead.

Thermometers depend upon the expansion of liquids & metals when subjected to heat. The thermometers used in Europe are Fahrenheit's — Reaumur's the Centegrade. The Zero point of Fah: is the cold produced by mixing equal quantities of snow & common salt. As 32° is the freezing point of water and the freezing point of water = Zero of Reau: = Zero of Centegrade. The boiling point of Fah: = 212 = 100 Cent: = 80 Reaumur. Thus;

Fah:		Cent:		Reau:
180°	=	100°	=	80°
1	=	$\frac{5}{9}$	=	$\frac{4}{9}$
$\frac{9}{5}$	=	1	=	$\frac{4}{5}$
$2\frac{1}{4}$	=	$1\frac{1}{4}$	=	1

Hence it follows,

1/: To reduce the Cent: to Fah:;
Multiply by 9, divide by 5 & add 32

2/ To reduce Fah: to Cent:;
Subtract 32, divide by 9 & multiply by 5

3/ To reduce Reaum: to Fahr:;
Mutiply by 9. divide by 4 & add 32.

4/ To reduce Fah: to Reaum:;
Subtract 32 divide by 9 & Mult. by 4.

5/ To reduce Reaum: to Cent:;
Mutiply by 5 and divide by 9.

6/ To reduce Cent: to Reaum:;
Mutiply by 9 and divide by 5.

Dr Dalton calculated that the expansive force of freezing water, is equal to a pressure of 2000 lb on the square inch.

LIQUEFACTION

All bodies except Alcohol have been solidified, that exist at Common Temperatures in a liquid State. The point at which liquefaction takes place is called the melting point, or the point of fusion. When a lb of water at 32° is mixed with at lb at 172, the resulting temperature is 102, or the mean between 32 & 172. But if a lb of water at 172 is mixed with a lb of ice at 32°, the ice is melted & the temperature is only 32°. Consequently 140° deg: of heat are necessary to melt ice, or in other words, this quantity of heat becomes latent. Hence 140° is the Calorific of fluidity of water. Water becomes solid at 32°. Mercury at 39°. Tin at 400° Lead at 600°. Water left tranquil in the receiver of an air pump, may be cooled at 21°, but whenever it is agitated it immediately rises to 32° & freezes.

Freezing mixtures.

From any temperature.

Muriate of Soda	1.	
Snow	2	- 5
Common Salt	2	
Muriate of Ammonia	1	- 12
Snow	5	
Muriate of Soda	10	
Muriate of Ammon	5	
Nitrate of Potass	5	- 18
Snow	24	
Muriate of Soda	5	
Sul: ammonia	5	- 25
Snow	1	

Dilut. Sulp: acid	2		Concn: Nitr: Acid	5	
Snow	3		Snow	8	
The temp: falls from 32 to	23		temp. falls from 32 to	27	

Concn: Mit: Acid	4		Muriate of lime	5	
Snow	7		Snow	4	
to	30		to	40	

Cryst^{d} Muriate of lime	3		Fused Potash	4	
Snow	2		Snow	3	
to	50		to	57	

The simplest Mext is

Water	16
Sal: amon	5
Mit: Potash	5

NB. This last mixture has the advantage that the salts when dried are as good as ever. This mixture is used in the East Indies for cooling wines.

The Theory of cooling mixtures depends upon the fact that by the solution of a body, a considerable quantity of Heat becomes latent, and consequently cold is produced.

The quantity of heat that disappears is called the Calorific of fluidity.

Hence the more rapidly a body dissolves, the better is it fitted for forming a freezing mixture. When a bottle of wine is surrounded by a freezing mixture, the cold is produced by the mixture in the act of dissolving extracting heat from the body. Did heat not become latent; when a body is dissolved every Alpine country, would be deluged at the return of Spring, because whenever the temperature is above 32, the whole snow would melt instantaneously - but the temperature of snow water, does not rise above 32°. till the whole is dissolved - The ice therefore melts gradually -

8

If different liquids at different temperatures be united the resulting temperature is not the mean between the two. For if a ℔ of Mercury at 140° be mixed with a ℔ of water at 40°, the temperature will only be 45°. The Mercury has lost 140° & the water has only gained 5°. This experiment proves incontestably that 28 times more heat is required to raise water one degree, than is required to raise mercury.

Experiment. Take a ℔ of water at 185° and a pound of Mercury at 40°. The temperature of the mixture will be 180°. The water has lost 5°. & the mercury has gained 140°. This is called the capacity for heat, but Specific Calority is the word.

The heat required to heat equal quantities of water, Sperm: Macedi oil, Mercury, to one degree, is in the ratio of 28, 14 - 1. for instance the quantity of heat necessary to raise a pound of water one degree, would raise Sperm: Macedi oil 14 degrees & Mercury 28 degrees.

Vaporization

Vapour expands $\frac{1}{480}$ of its volume at 32° by every degree of heat, and all vapours follow the same ratio. Sulphuric ether boils at 96°. Alchahol at 173° & water at 212°, when in a metallic vessel at at 214° when in glass. Metallic It is a curious fact, that putting iron filings into a vessel, causes it to boil at a lower temperature. The boiling point of water depends upon the height of the thermometer. An elevation of 530 corresponds to the lowering of the boiling point 1 degree. Oil of Turpentine boils at 316° & mercury at 660. In vacuo liquids boil 140° lower than in open air. Water boils at 72°. Alchohol at 33° & Ether at 44°. Liquids are not necessarily hot because they boil, but no liquid boils until its particles have acquired an elastic force, sufficient to overcome the pressure of the air. The common fulminating glass boils by the heat of the hand & Ether boils in a vacuo at a temperature sufficient to freeze mercury. The tension of steam at 244° is equal to two atmospheres, and at 290° is equal to three. Water does not become hotter as it boils, therefore it is not economical to boil it at a high temperature.

The latent heat of steam is 1000, or if you pass 1lb of steam through 1000 lb of water, it will raise it one degree. Steam occupies 1696 times as much space, as an equal weight of water. Thus if we fill an empty ball with water & shut it up, when the water boils it will burst.

Evaporization depends on 3 circumstances, 1st extent of surface 2 the temperature, 3 the state of the air as to dryness, 4 the stillness of the atmosphere, 5 the pressure.

Most rain falls near the equator, because the evaporation there is greater. At Granada 126 inches fall annually, in London only 32.

Incandescence or Ignition

All solids and fluids which are converted into vapour become luminous when heated at 800 in the dark & 1000 in the light. They have a red light at first and then become white.

Communication of Heat

Heat is communicated in two ways. 1st by condensation. 2nd by radiation.

When one end of a metallic rod, is placed in the fire, the other soon becomes hot. A piece of burning charcoal can be held in the hand, without producing any inconvenience. Hence metal is a good conductor of heat & charcoal a bad one. When a person has money in his pocket & stands near the fire, the money becomes intolerably hot. The pocket feels comparatively cool although both are exposed to the same temperature. Liquids conduct heat downwards very slowly, if at all; for ether can be made to boil on the top of water, while the bottom is perfectly cold. But if heat be applied at the bottom of the vessel, the water soon becomes heated. This is accounted for by the particles of the water expanding & thus becoming specifically lighter & ascending to the surface. Furs & feathers are the worst conductors of heat.

Besides being communicated, the effects of heat are felt at great distances without heating the intermediate space. Thus for instance if a red hot ball be placed in one of the foci of two parabolic mirrors, & a thermometer be placed in the other, the thermometer will indicate a much higher heat, when so placed, than when either nearer or further from it - To produce heating effects, calorific must be absorbed - for the luminous as well as the calorific rays pass through masses of ice without melting it, whereas if these rays be concentrated in a point, they will inflame powder, or even melt a metal -

Sir J. Leslie found in his researches on heat, that the surface of a body influences much its power of radiation. A rough surface absorbs heat most rapidly & also radiates most copiously; Whereas a body that is polished reflects most powerfully, but its radiating & absorbing powers are most feeble - Hence culinary utensils should be highly polished to retain heat, though if intended to radiate it. —

Colour also has great influence on luminous caloric. Black absorbs heat & emits most powerfully; & hence a black dress is the most adapted either for summer or winter wear - On this account it is a beautiful adaptation of Providence, that the skins of animals in the northern regions, become white during the winter, & the bellies of animals, which are low & much on the ground, such as the hare —

Galvanism

Those actions that are called Galvanic were first discovered by Madme Galvani, the wife of an Italian Physician, observing a student cutting the flexor muscle leg of a frog, he observed convulsive twitchings, he indeed this experiment can easily be repeated by touching the belly of the muscle of a frog with one metal & the nerve of the muscle at the same time with another. Also when a flounder is placed on a silver plate, touch the silver plate & the flounder at the same time with a piece of zinc, the flounder will be convulsed. —

Volta a professor at Pisa, improved upon the discovery of Galvani, & considered that by increasing the number of plates of metal that the Galvanic effect would be increased. Hence the origin of the "voltaic pile." Every voltaic pile consists of 2 metals & some dilute or acid menstruum. An excellent liquid for the Galvanic battery or voltaic pile is produced by mixing 40 parts of water, 1 of Sulphuric acid & 2 of nitric acid.

In the arrangement of the plates, two metals must be together & the solution must intervene, however metal commences the battery, the other must terminate it.

The wire attached to the zinc, is the positive wire, That attached to the copper, the negative.

Effects of Electricity

1. It produces heat. Wires of different metals are rendered red hot by an electrical or Galvanic current, every combustible body is inflamed.
2) light. The spark is visible, when the galvanic current is broken, & when Charcoal points are fixed upon the conducting wires, almost the most intense artificial

-ficial light is produced. It is a remarkable fact that Galvanic light is equally intense under water.

3/ It produces Chemical effects. When the poles of a Galvanic battery are placed in water, oxygen is evolved at the positive pole, & hydrogen at the negative. Hence Hydrogen is called a positive electric & oxygen a negative. In the same manner all metals appear at the negative pole, & acids at the positive. It was in this way that Sir H. Davy discovered Potassium.

Also if the poles of a battery be placed in a solution of sulphate of soda, mixed with cabbage water, the liquid at the positive pole becomes red, indicating that the acid has been disengaged; and at the negative it becomes green, thus showing that the soda has been set free. The same thing happens, whether only one glass is used, or two glasses connected with cotton. Also if Iodine of Potassium be dissolved in a solution containing starch, the iodine is set free, whenever connection is made between the two poles, the solution becomes blue, indicating the presence of free Iodine. Metallic lead & copper, can also be obtained from their respective salts by Galvanism. The metal appears at the negative pole.

4/ Galvanism produces the same effects as magnetism. For if iron filings be brought to the conducting wire of a galvanic battery when in action, the particles are attracted & arrange themselves at right angles to the current. Indeed it is believed now, that the magnetism of the earth is produced by galvanic currents circulating around it, & this galvanism is excited by the heat of the sun in its diurnal revolution. When ships are long exposed to the action of sea water, their copper

become much corroded; but it is found that by attaching a small piece of Zinc to the copper, it is not acted upon by the sea water. This discovery was made by Sir H. Davy. The Zinc is corroded, but not the copper. But although this discovery entirely saves the coppering of the ships, it has been abandoned by the British navy, because when the copper does not rust it form verdegris, carbuncles & other destructive animals adhere to the bottom of the vessels, thereby [illegible] sailors. –

This experiment can be illustrated by placing two pieces in vessels containing ammonia for it will found that whilst both would be corroded, if no Zinc were attached, by attaching the smallest particle of Zinc to one, corrosion is entirely suspended.

Water

In almost all natural & artificial bodies water is found. It constitutes $\frac{3}{4}$ of the weight of animals. and in trees it abounds. Acids when deprived of water loose their properties & therefore water is essential to their existence. In combining; when the solid matter exceeds the water, & when water forms part of the solid body without rendering it liquid, a hydrate is formed, as is exemplified in the well known operation of slaking lime: the intense heat produced in this operation caused by the water giving out its caloric of fluidity & assuming a solid form. Some bodies have such an affinity to water that no known temperature can entirely dissipate it. For alumen or clay contains $\frac{1}{10}$ of its own weight of water at a heat that fuses iron. No water can be found perfectly pure; whether it be obtained from the atmosphere or from Springs & rivers. Snow & rain-water is the purest; but these contain whatever extraneous substances float in the air & water from springs

is contaminated by particles of those minerals, over which it has run, before it issues from the ground.

II. Water contains carbon or carbonated water) such as that at Piedmont & Spa sparkles when poured it forms a white precipitate i.e. Carbonate of lime. Nitric acid & Muriatic acid or an additional quantity of the carbonated water dissolves this. Acetate of lead also manifests the presence of carbonic acid. This is dissolved by an excess of acetic or Nitric acid.

III. Alkaline waters reddens Litmus paper.

IV. Calybeate water contains Iron, as Cheltenham. This causes a black precipitate with nut galls, a green (which ultimately becomes blue with Muriate of Potash.

V. Sulphureous water contains Sulphuretted Hydrogen, as Harrowgate & Moffat waters. The Sulphuretted Hydrogen is evolved by boiling: or when the water is kept, a film of Sulphur forms at the top. This water has the smell of rotten eggs & gives a black precipitate with Acetate of Lead.

VI When water contains Oxygen, it causes a brown precipitate with Sulphate of iron: this is produced by a Peroxide of Iron being formed, which is insoluble in water. Hardness in water is caused by Sulphate or Carbonate of lime being dissolved in it; but this may be counteracted by Soda or Potash.

3 pints & $\frac{1}{2}$ of water, contains 3 cubic inches of carbonic acid & 1 inch & $\frac{1}{2}$ of common atmospheric air.

CONSTITUENTS of Water

HYDROGEN

This body was discovered by the Hon^ble H. Cavendish in 1776.
It is colourless, permanently elastic & its specific gravity
is 0.0688, in other words 100 cubic inches
of it weighs 2 1/10 grains. Hence a balloon filled with Hy-
drogen gas ascends into the atmosphere. This gas will
neither support life or combustion; it is however not
altogether irrespirable; because when the Hydrogen adapter
that when a small quantity of Hydrogen gas is inhaled,
the voice becomes much shriller; but has also been ascer-
tained, that stops will lose a considerable time in
being. This gas is highly combustible when mixed with
half its volume of atmospheric air, it explodes with violence.
The intolerable light of the Hy- Hydrogen Microscope, called
= mond light, is produced by the combustion of this mixture.
The powerful heat of the Hy- Hydrogen blow-pipe is caused
in the same manner. When 200 cubic inches of Hydrogen
are mixed with 100. cubic inches of Oxygen, & exploded, the
quantity of Oxygen disappears & 100 cubic inches of water
remain. The burning of Hydrogen also produces a watery
vapour; hence, water is an oxide of Hydrogen.
When Hydrogen is burnt in tubes, musical sounds are
produced, which are caused by the Hydrogen exploding
in the tubes & the vibration thus produced.
Hydrogen is inflamed also by spongy platinum.
Hydrogen gas is formed by pouring sulphuric acid upon
Zinc or Iron.
The rational of the process is as follows.

Water. { 1 Hydrogen . . . . . 1 Hydrogen
8 Oxygen . . . . . 82 Sulphate of Zinc (white Vitriol)

34 Zinc . . . . .

40 Sulphuric acid . . .

Water { 1 Hydrogen . . . . . 1 Hydrogen
8 Oxygen . . . . . 76 Sulphate of Iron (Copperas)

28 Zinc . . . . .

40 Sulphuric acid . . .

Thus is seen 1 grain of Hydrogen to every 34 of Zinc. 8 of iron employed as 47 cubic inches weighs a grain. Therefore if we multiply the weight that oxygen be obtained, by 48, we shall obtain the volume.

Hydrogen maybe obtained by passing water through a Gun barrel with iron in it, heated to redness. The oxygen forms an oxide with the iron & hydrogen is evolved. This explains the explosion of steam boilers. Hydrogen gas is without smell.

This smell is produced is caused by sulphuretted Hydrogen, as the Zinc of commerce is always alloyed with sulphur which is freed by passing it through Potash. The watery vapour formed by Hydrogen & Oxygen is the same volume as the Hydrogen employed, for the oxygen disappears. Atmospheric air contains $\frac{1}{5}$ of oxygen by volume, therefore every measure of Hydrogen requires $2\frac{1}{2}$ of atmospheric air to explode. In other words 100 cubic inches of Hydrogen requires 250 atmospheric air to explode it. This explosion is feeble in comparison with that, when Oxygen is employed. Excess of atmospheric air adds much to the loudness of the report.

In mentioning, that Hydrogen & Nitrogen form Ammonia (the Basis of the Alkalies) besides producing acidity with Chlorine.

In order to procure Hydrogen, take 7 parts of Zinc 10 of Sulphuric acid & 60 of water. The medal must be put in first & the Etna ought never to be filled more than a third on account of the great effervescence that occasionally occurs. This however depends on the strength of the acid.

In using iron 6 parts will be sufficient with the same quantities of water & acid.

To make Gold figures in silk;

Dilute a solution of nitro-muriate of Gold with three its quantity of water & with the solution, paint flowers or leaves on white silk. Then expose the silk, (kept moist with pure water) to a current of Hydrogen gas, which is to be forced through a pipe from a vessel containing it. The Hydrogen will reduce the oxide of gold; the colour wet of the painting will change from yellow to green & the figures will soon shine with all the splendour of gold.

To make Silvery figures on silk;

Immerse a piece of silk in a Diluted solution of Nitrate of silver (one of silver & 10 of water) & expose it while wet to a current of Hydrogen gas. The silver will quickly be reduced. Various colours blue, purple, red, orange, yellow, accompany the reduction & the threads of the silk at length appear as silver wires.

To coat Ivory with silver;

Dip it in a solution of nitrate of silver & suffer it to remain, till it becomes yellow: then take

it out of the solution & immerse it in a tumbler of pure water & immediately expose it in the water to the rays of a bright sun. When the strip has been exposed for about 3 hours to the action of the sunlight it will become black; but on rubbing it, the black surface will be changed into a metallic one resembling a slip of fine wire. Though the coat of metal is extremely thin, yet, when the nitrate of silver has penetrated deep; as one coat is worn off, another is formed bythe action of the light.

Experiments

1/. Fill a jar with Hydrogen & apply a light, a smart explosion is produced.
2/. Plunge a burning taper into a jar of Hydrogen & the taper is extinguished.
3/. Apply a light to a small jar of Hydrogen & the gas burn with a pale lambent flame.
4/. Make Hydrogen in a Florence flask, having a tube of a pipe in the cork & apply a light, the phosphoric candle is formed.
5/. Apply a piece of spongy Platinum to the gas, it burns.
6/. Place a tube over a burning jet of Hydrogen Lyrical sounds are produced.
7/. Soap bubbles blown with Hydrogen gas ascend in the atmosphere.
8/. Fill a turkey's craw with Hydrogen. it ascends.
9/. Blow soap bubbles with a mixture of Hydrogen (2) & oxygen (1) & apply a light & they will explode
10/. Fill a soda water bottle with the mixture &

11) Drop in a piece of spongy platinum & with explosion is produced

12) Over a jet of burning hydrogen gas, place a dry jar & a moisture is deposited.

13) When an ignited jet of Hydrogen (2) & oxygen (1) is directed on a piece of lime, an intense light is produced.

14) The same mixture produces the most intense heat that can be formed.

Oxygen

This gas was discovered by Dr Priestly & Birmingham - in 1774 & by Hiel about a year & two afterwards without any knowledge of Priestly's discovery. This gas was called oxygen by Lavoisier, which means "acid former." - (a οξυς & γενναω) because he believed, that all acids contained oxygen. This gas maybe obtained from the peroxide of manganese peroxide of lead & mercury oxide & Chlorate of Potash, which maybe further elucidated by the following table.

To obtain oxygen gas from peroxide of manganese by means of heat -

Materials employed.

44 Peroxide of Manganese { Oxygen 8 . . . . . Oxygen
Protoxide 36 . .

44 Peroxide of Manganese . . . . . Deutoxide

hence 88 peroxide yield 8 of oxygen.
To discover therefore the volume of oxygen, that will be yielded by a given quantity of manganese, divide by 11 & multiply by 3: for a grain of oxygen gas occupies 3 cu: - ic inches. If sulphuric acid be used.

44 peroxide of Manganese { Oxygen 8 - - - 8 oxygen
Protoxide. 36.

44 Sulphuric acid - - - - - - - - - - - - 76 sulphate of Manganese.

To obtain oxygen by peroxide of mercury

216 peroxide of Mercury { 16 oxy ——— 16 oxygen
200 mercury (fly off)

N.B. The mercury that distills over is exceedingly pure. & ought to be used for chemical purposes.

Hence from 124 grains of chlorate of potash, 48 grains of oxygen gas are produced or 144 cubic inches.

Oxygen gas is colourless, it is inodorous & has no taste.
It is a perfect negative electric, always appearing at the positive pole of the galvanic battery. That is at the wire attached to the zinc plate. Its specific gravity is 1.1111 consequently 100 cubic inches weigh 33.88888 grains
Ordinary Combustion is nothing else but oxygen combining with the burning body & always produces an oxide or an acid
It is a powerful supporter of combustion.
When it unites with a base, it forms either oxides or acids.
When iron wire is burnt in oxygen, it forms oxide of iron & when phosphorus, phosphoric acid.
When a body is burnt in oxygen, it forms oxides of iron & when phosphorus an increase of weight is produced & therefore the combustion of any body instead of diminishing its weight adds to it; if we collect all the products. By Lavoisier it was discovered, that this increase of weight, is exactly equal to the quantity of oxygen, that has disappeared.
Oxygen gas forms $\frac{1}{2}$ of the atmosphere & $\frac{1}{3}$ of the water of the globe, if we estimate it by volume & by weight.

Experiments

1/ Take a match, with a spark of fire at the end: plunge it into a jar of oxygen & it will burn with brilliancy.
2/ lighted rock sulphur burns in oxygen gas producing a light.

blue flame & forming sulphurous acid gas.
3/ Phosphorus burns in oxygen gas with great splendour forming phosphoric acid.
4/ Charcoal burns in oxygen gas, emitting beautiful scintillations.
5/. Iron emits brilliant scintillations forming oxide of iron
6/ Combustion of Zinc. Take some filings of zinc form a ball of them & affix it to a copper wire; insert a small piece of phosphorus in to the ball set fire to it & introduce it quickly into a bottle filled with oxygen gas; the zinc will take fire & burn with a beautiful green flame surrounded by a white one.
7/. Arsenic burns in oxygen if previously dipt in turpentine, & set fire to before plunged into the gas.
8/ Filings of steel, antimony, cobalt, zinc or iron be placed upon ignited charcoal, they will burn with much splendour.
9/ A mixture of charcoal powder & nitrate of strontia, previously ignited burn in oxygen with a rose Red flame.
10/ A mixture of 1 part of boracic acid & 3 of charcoal previously ignited, burn in oxygen with a green flame
11/. A mixture of 1 part of nitrate of baryte & 2 of charcoal previously ignited, burn in oxygen with a ~~reddish~~ yellow flame
12/. Equal parts of lime & charcoal powder, burn in oxygen with an orange Red flame.

The Atmosphere

The atmosphere, which sourrounds the earth is of a blue colour, which is proved by the azure tinge of distant mountains. were its density the same as at the earth's surface, it would extend to an altitude of 5 miles & a half But on account of the diminished pressure in higher altitudes, it is supposed to extend to the height of 45 miles & a half at 2 miles and a half we have passed through $\frac{1}{2}$ of the atmosphere at 5 miles, there is only $\frac{1}{4}$ above us at 7 $\frac{1}{2}$ $\frac{1}{8}$ taking altitudes in arithmetical progression, the densities are in geometrical.

The atmosphere is composed of Oxygen & Nitrogen gas, in the proportion of 4 of Nitrogen to 1 of oxygen or in other words Oxygen composes $\frac{1}{5}$ of the atmosphere of the earth.

The pressure of the atmosphere on one square inch is estimated at 15 lbs. The composition of atmospherical air was discovered by Lavoisier - he heated mercury in contact with atmospheric air & observed that the air was diminished & what was left was incapable of supporting either respiration or combustion by exposing mercury to a higher heat, the gas, that the mercury had absorbed was again evolved. The mercury was increased in weight & the gas that was obtained by applying a high heat to the mercury was oxygen: besides Oxygen & Nitrogen gas there is also found in the atmosphere a trace of Carbonic acid gas even in the highest altitude it is heavier than either oxygen or Nitrogen gas.

Dalton explains its presence by saying that gases act as vacua to each other & therefore do not arrange themselves according to their specific gravities. At one period it was believed that the utility of atmospheric air depended on the quantity of oxygen it contains but whenever the air is collected & analyzed the products are the same hence the wholesomeness of atmospheric air does not at all depend on its chemical constitution. The other compound of the atmosphere is nitrogen. Its characteristics.

This element was discovered by Dr Rutherford of Edinburgh in 1772 & was proved by Lavoisier to be a constituent of the atmosphere in 1775. This gas is irrespirable & colourless it can easily be obtained by burning phosphorus in a jar containing atmospheric air over water. The oxygen of the atmosphere unites with the phosphorus forming phosphoric acid & Nitrogen remains. The properties of Nitrogen are entirely negative. It is lighter than atmospheric air.

On the Circulation of the Blood

Respiration

In the heart there are 2 divisions, the right auricle & ventricle & the left auricle & ventricle. The veins conduct the blood to the heart, the veins conduct the blood from the heart to the different members of the body. If the blood be circulating on the surface of the body, it is conducted by veins, which in-organise into one another into the two large veins (vena Cava superior & vena Cava inferior) into the right auricle of the heart. From the right auricle it is propelled by one beat into the right ventricle. From the right ventricle it is propelled by the pulmonic artery into the lungs, where it comes into contact with atmospheric air. From the lungs it again conducted to the heart by the pulmonic vein into the left auricle. From the left auricle, it passes into the left ventricle by means of this aorta is again distributed through the whole body. In arteries beats, a vein does not beat. Any artery is elastic a vein is flaccid. A vein will heal an artery will not. A beautiful provision of nature - an artery is always dilated while the veins are on the surface.

Between the division & the mouths of the large arteries are valves to prevent the blood from regurgitating. It was from the existence of these valves that Harvey proved the circulation of the blood. Arterial blood is of a scarlet colour. Venous blood is dark. The former contains pure oxygen the latter carbonic acid gas, which is evolved from the lungs. The heat of animals is supposed to be produced by the conversion of oxygen gas into carbonic acid gas, in the course of circulation. Experiment Breath into lime water & it instantly becomes muddy.

Protoxide of Nitrogen

Laughing Gas

This gas is obtained by exposing nitrate of ammonia to a heat of between 400 & 600 of Fahrenheit. Above that it explodes. Nitrate of Ammonia may easily be procured by adding Carbonate of Ammonia to dilute nitric acid, till the acid is exactly neutralized. Nitrate of Ammonia is compounded of nitric acid & Ammonia in the proportion of 54 nitric acid to 17 of Ammonia.

Nitric acid is compounded of 40 oxy & 14 nitrogen

Ammonia . . . . . 14 Nitrogen & 3 hydrogen.

By the action of heat these elements arrange themselves differently. The hydrogen takes as much oxygen as is necessary to form water & the remainder of the oxygen combines with the nitrogen, to form protoxide of Nitrogen. This is more fully elucidated by the following table.

Nitrate of Ammonia (71)
- Nitric acid (54)
  - 8 oxy . . . . 22 Protoxide of Nitrogen
  - 8 oxy . . . . 22 Protoxide of Nitrogen
  - 8 oxy
  - 8 oxy
  - 8 oxy
  - 14 Nitrogen
- Ammonia (17)
  - 14 Nitrogen
  - 1 hy . . . . 9 water
  - 1 hy . . . . 9 water
  - 1 hy . . . . 9 water

Since from 71 grains of the nitrate of Ammonia 46 grains of the protoxide are provided & as 100 cubic inches weigh 46 grains and a half; hence from 71 grains of Nitrate of Ammonia, we shall obtain 26 cubic inches of laughing gas. This gas supports combustion more powerfully than atmospheric air only contains $\frac{1}{2}$ its part of

oxygen, whereas ~~the~~ atmospheric air only contains $\frac{1}{5}$. This gas is colourless, sweet tasted & rather an agreable odour to ~~the~~ ages - Cold water absorb it, but not sparingly. 4 pint ~~of~~ ~~water~~ will ~~not~~ is water impregnated with this gas. The chief characteristic of this gas is that it acts as a powerful stimulant on the animal frame. Extraordinary sensations of a highly pleasurable kind are produced & increased exhilaration of ideas follows & also a great propensity to involuntary laughter & the greatest exhilaration without the debility & languor accompanying intoxication.

Experiments

Most of those substances which burn in oxygen will also burn in this gas but the combustion is always more languid.

P.S. Great care must be taken that the nitrate of ammonia used in the preparation of this gas be perfectly neutral & that the solution is not exposed to such a heat, as would explode the retort.

Deutoxide of Nitrogen

To obtain this gas introduce Copper filings into the retort containing diluted nitric acid. Red fumes arise & the gas may be collected whenever them disappear. 200 grains of Copper may be taken & 1oz of Nitric acid diluted with 900 of water.

Nitric acid (54) { Nitrogen 14 . . . . . Deutoxide of Nitrogen (30)
Oxy 8.
Oxy 8.
Oxy 8. . . . . Peroxide of Copper (80)
Oxy 8.
Oxy 8.
Nitrogen 14 . . . . . Deutoxide of Nitrogen (30
Nitric acid (54) { Oxy 8.
Oxy 8. . . . . Peroxide of Copper (80)
Oxy 8.
Oxy 8. . . . . Peroxide of Copper (80)

Copper { 32+32 = 64
32+32 = 64
32+32 = 64

Thus from 300 grains of Copper & nitric acid, we obtain 60 grains of Deutoxide of Nitrogen. 100 cubic inches of it weigh $31\frac{7}{10}$ grains Hence in round numbers from 300 grains of materials employed we obtain 200 cubic inches.

This gas is colourless but when it comes in contact with atmospheric air, it becomes an orange colour; nitrous acid fumes being formed. It is irrespirable. If it came to the lungs it would there come in contact with atmospheric air & fumes would be formed. It extinguishes a Candle but phosphorus when ignited, burns in it with considerable brilliancy.

Experiments

Mix equal quantities of hydrogen & this gas & when a light is applied a beautiful lambent flame is produced.

but in a jar 1 part of oxygen & 2 of deutoxide of nitrogen over water the two gases disappear.
On account of the facility with which this gas absorbs oxygen from atmospheric air, it was once employed to a great extent for the purpose of Eudiometry, which science had for its object to ascertain the salubrity of atmospheric air, believed to depend on the quantity of oxygen it contained. When a quantity of the deutoxide of nitrogen extracts the oxygen Nitrous acid is formed, which is absorbed by the water & the diminution of bulk indicates the quantity of oxygen in the atmosphere.
Let a jar be taken the contents of which are indicated by measure marks. The sides of this be filled with atmospheric air & the other 2 with water. The mouth of the jar being under water, Pass into the jar 2 parts of deutoxide of nitrogen; instead of the jar being filled, (as it would be were there no condensation) the water rises in the jar only 4 parts remain, which are pure Nitrogen. Thus again showing that the fifth part of atmospheric air is oxygen.

Nitric acid is obtained by pouring Sulphuric acid upon Salt-petre & applying heat.

Aqueous Sulph. acid (96) { Water 9 / Water 9 / Dry acid 40 / Dry acid 40 } — 72 aqueous Nitric acid.

Nitrate of Potash 102 { Nitric acid (54) / Potash 48 } — 128 Bisulphate of Potash

Tests of Nitric acid Nitric acid is easily recognized by its powerful action on Tin - Zinc - Copper - Iron & Mercury, when it fumes copiously -

Nitric acid therefore is used for action upon copper & for Counteracting the consequitive effects of opium - With Muriatic acid it forms Aqua Regia or the Solvent of Gold when poured upon burning charcoal it increases the deflagration. This acid is always obtained accompanied by watery vapour.

Iodine

Iodine was discovered in 1812 by Monsieur Courtois manufacturer of salt-petre in Paris. It is called Iodine from the Greek ιοδης from the colour of its fumes. Its properties were first discovered by Gaylussac & Sir H. Davy. It is easily obtained from the ley in the manufacture of carbonate of soda from Kelp or barylla. The process usually followed for the preparation was that given by Dr. Ure of Glasgow. The ley is heated to 230° & thrown into a stone pan one part of sulphuric acid is mixed with every 8 of the ley. Effervescence ensues & sulphur & sulphate of soda are deposited when the liquor cools. The hydriodic acid which remains, is separated from the sulphur of the salts by filtration & the sulphur & sulphate of soda are obtained by the filtering. In the last stage of the process the Iodine is obtained by mixing 1000 grains of the peroxide of manganese with every 12 measures (apothecaries) of the filtered liquid receiving the fumes in a cool receiver. The fumes constitute Iodine.

125 Hydriodic acid { Hydrogen 1 ..... 0 water
Iodine 124 ..... Iodine 124.

44 Peroxide of Manganese { Oxygen 8 ---
Protox. of Manganese 36.

125 Hydriodic acid ... 125 ..... 161 Hydriodate of Manganese.

Iodine at common temperatures is a soft pliable opaque solid of a dark bluish black colour & metallic lustre. When slowly sublimed, its vapour condenses in rhomboidal crystals or plates. It has a pungent sour & acrid taste. It stains the skin of a yellow colour & destroys the vegetable colour though it acts more feebly than Chlorine.

Experiments.

Put a little Iodine with water in a flask or retort; the vapour of the Iodine rises along with that of the water.

Expose Iodine to a gentle heat in a flask violet fumes arise, which form into crystals about the sides of the vessel.

Cut phosphorus into thin slices & put upon them a little Iodine combustion immediately ensues.

The test of Iodine is starch

Small doses of Iodine produce much emaciation.

Iodine, chlorine & oxygen are negative electrics always appearing at the positive pole of the Galvanic battery.

Hydriodic Acid

Hydriodic acid has no smell - It is easily procured by mixing Iodine with water & passing a stream of sulphuretted hydrogen through it - The sulphuretted hydrogen is decomposed. Sulphur is deposited & the hydrogen of the sulphuretted hydrogen unites with the Iodine, forming Hydriodic acid. The sulphur is separated by filtration.

Experiments

Pour a small quantity of the acid into a dilute solution of litmus paper, the colour immediately changes to red.

Pour a few drops into 6 glasses each containing an oz or two of water. To the first add a single drop of a solution of the bichloride of Platina; the whole liquid will immediately become of a dark brown colour ultimately changing to black. This is a most delicate test of Hydriodic acid. To the other glasses pour a few drops of the following liquids; viz solution of nitrate of silver, a yellow precipitate appears, which finally becomes white. (2) a solution of the Bichloride of Mercury yields a precipitate at first yellow, but which soon becomes a brick red. (3) A solution of the acetate of lead gives a deep yellow precipitate.

Pour strong nitric or muriatic acid into a solution of Hydriodic acid. The iodine is set free, which may be tested by starch, producing a blue colour

Pour in chlorine water the same effect is produced.

Fluorine

Fluorine is obtained from Derbyshire Spar. the fluate of lime of the Chemist & Fluor Spar of the Mineralogist. Fluor Spar is always found crystallized in cubes. Its colours are various, red, blue & green. Sometimes green crystals are found with blue edges & red crystals are sometimes tinged with green. The finest specimens of Fluor Spar are called Chrophane. This mineral, which is found in Siberia is highly phosphorescent; it emits lights even by the heat of the hand. All Fluor Spars becomes phosphorescent by heat. Fluorine however is interesting to the chemist chiefly from its producing,

Fluoric Acid

This acid is easily produced by pouring Sulphuric Acid upon Fluate of lime. The sulphuric acid unites with the lime forming sulphate of lime & fluoric acid is evolved. This acid was discovered by Sheele in 1771. Fluoric acid at the temperature 32° Fahrenheit is a colourless fluid. remains in that state as far as 69° if well corked up. When exposed to the air, it immediately flies off in white fumes. The vapour of this acid is frequent in the extreme, more so than that of any other of the gases. Of all known substances, it is most destructive to the organization of the animal frame. When a drop of the concentrated acid of the size of a bean. Spin's head, comes in contact with the skin, instantaneous organization ensues followed by deliquiation, which is very difficult to heal. Therefore

in experimenting with this acid, extreme precaution is necessary.

Etching upon Glass. In the middle of the sixteenth century when glass was manufactured in the Venetian states, - was held in the highest reputation by the rest of Europe. figures were etched on it with diamonds. about 100 years after-wards Athanard excited by a powerful acid having a corrosive effect on glass. used it for etching, but kept it-secret. as it was not known. till Schule discovered it. The difference of the figures by the old & new hands I mean raised or with in this; that the old were dug out by the acid, while the rest of the glass was uncovered but those of the new hands were raised, being the uncovered glass. The varnish ge-nerally used is oil of spike or common turpentine. Good crown glass is best. A plate of this should be heated by a sand bath & then it should be covered with wax or varnish. The pane then must be left to cool. A shallow wooden basin of wedge wood ware should be procured large enough to cover the design. This must be filled with fluate of lime made into a paste with sulphuric acid. The best proportion is 2oz fluor spar to a vessel contai-ning a pint. The glass must be placed in this & gentle heat applied. after the glass has stood for a-bout ½ an hour, it must be washed with water to remove the fluoric acid. The wax must then be scraped off, when the design will be found perfect-ly etched on the glass.

CHLORINE

This gas was discovered in 1770 by Scheele, when investigating the nature of manganese; he designated it by the name of Dephlogisticated marine acid. The French Chemists called it Oxygenized muriatic acid afterwards Contracted into Oxymuriatic acid: a name which it still retained by some Chemists till H. Davy first proved it to be a simple body. This gas is a greenish yellow colour & derives the name Chlorine from Χλωρος. And. It has a pungent suffocating odour, even when diluted with much atmospheric air it is of a disagreable detringent metallic taste. In operating with it, care must be taken not to allow it to escape, as it frequently produces a degree of irritation in the lungs & difficulty of breathing with a total inability of taking full respiration which sometimes remains for days even when a single Inspiration has been made. In large quantities it produces a tendency of Sanguification & bleeding at the nostrils. In manufacturing this, when it is used in considerable quantities, the workmen have been known to fall down Senseless. This however does not now occur as Chlorate of lime is substituted for it. Dr Cochrane of Glasgow first introduced this it in this Country for the cure of bleeching. Soda Chloride of lime; but it did not answer so well as Chloride of lime.

Persons affected by Chlorine gas; if immediately removed to the open air & have cold water poured upon them soon recover. When this gas is passed into the lungs it has been recommended to take much diluted ammoniacal water. If nothing be at hand, holding the head over

hot water breathing into it, recovers one -
To obtain Chlorine 1 part of Peroxide of Manganese with 4 times its weight of muriatic acid must be mixed in the retort by applying heat. the gas is evolved, which must be collected over hot water as cold absorbs it. The rationale of the process is as follows

37. Muriatic acid { Chlorine 36 ..... 36 Chlorine.
Hydrogen 1 ..... 9 water

37 Muriatic acid .... 37 Muriatic acid.

44 Peroxide of Manganese { Oxygen 8.
Protoxide of Manganese 36 ... 73 Muriate of Protoxide of Manganese

To obtain Chlorine from salt, take 400 grains of salt, 3 drachms of Manganese, 12 of sulphuric acid mixed with 6 of water & apply heat, the result of the decomposition is as follows;

60 Chloride of Sodium { Chlorine 36 ..... 36 Chlorine (Gaseous)
Sodium 24 ..... 72 Sulphate of Soda (Glauber salts)

44 Peroxide of Manganese { Oxygen 8 .....
Protoxide of Manganese 36 .....

40 Sulphuric acid .....
40 Sulphuric acid, ... 76 Sulph. of Protox. of Manganese.

Experiments

Those flowers to moist Chlorine, they immediately lose their colour. N.B. Dry Chlorine does not bleach.
Pour Chlorine into a solution of litmus or Indigo, the solution immediately becomes colourless.
Reduce Antimony or Arsenic Nickel or Bismuth to powder & throw it into a jar containing Chlorine; it becomes incandescent. Heated mercury when introduced into Chlorine, burns with a red flame forming corrosive sublimate (a deadly poison).
The compounds of Chlorine, which are not acids are called Chlorides as Chloride of Soda. The best antidote to the deleterious effects of Chlorine is Ammonia.

Muriatic Acid

Muriatic acid always exists in a gaseous or aeriform state at common temperature & hence the liquid sold as muriatic acid is only water strongly impregnated with this gas; for when a bottle containing a solution of this is unstoked, the muriatic acid is evolved. To prepare muriatic acid is extremely easy. Expose common salt to a red heat for an hour or two to decompose any nitrates, with which it may be contaminated. Put the salt into a retort & pour over it an equal weight of sulphuric acid, which has been previously diluted with $\frac{1}{3}$ of it's weight in water & allowed to cool. By applying heat, the gas is eliminated;

Sulp. acid (40) { Hydrogen 1 . . . . . 37 Muriatic acid.
Sulp. acid dry 40
Oxygen 8 . . .

Chloride of sodium (60) { Chlorine 36
Sodium 24 . . . . . 72 Sulphate of soda (Glauber salts)

The most delicate test of muriatic acid is nitrate of silver with which it produces a white precipitate. (Chloride of silver) This precipitate when exposed to the sun becomes purple. The famous Mr. Wedgewood recommended chloride of silver for transferring paintings on glass to leather or paper. The process was as follows; The paper was moistened with a solution of chloride of silver. The glass was placed upon it & exposed to . . . The parts of the glass that had the lightest colour, transmitted the light most powerfully and necessarily that part upon the paper assumed a darker hue than those where the light was admitted more feebly & the parts that were dark on the painting were light on the paper & vice versâ. This method had however one disadvantage, which could not be remedied that as all the chloride of silver could not be discharged, in course of time the whole of the picture became equally dark.

Experiment. Take 2 retorts. Pour into one Ammonia into the other muriatic acid. Apply heat, the fumes in the stems of the retorts will be colourless; but if allowed to mix, dense flakes are produced, which are sal-amoniac & muriate of ammonia.

Agua Regia

Agua Regia, which is a solvent of gold & platinum, which no other acids can effect, is a mixture of nitric & muriatic acids, in the proportion of 1 of nitric to 2 of muriatic. When gold is dissolved by this mixture, the terchloride of gold is formed of a deep reddish brown colour. When these acids are mixed together, the solution first becomes yellow & then changes of a bright red colour. Whenever all the Chloride is expelled agua-regia looses its power of dissolving gold.

Protoxide of Chlorine

The protoxide of Chlorine was discovered by Davy in 1811 by its brilliant yellowish green colour was named euchlorine. To prepare this gas 12 parts of muriatic acid diluted with an equal weight of water & a very gentle heat applied by a small spirit lamp to 100 grains of the chlorate of Potassa & 120 or 240 of muriatic acid will be sufficient. The gas must be collected over a mercurial pneumatic trough, or in small bottles by displacement. Great care must be taken but it explode as it does at a moderate temperature. The spirit lamp should not play on the sides of the retort & the gas should come slowly away without much effervescence.

76 Chlorric acid	Oxygen 8	44 Protoxide of Chlorine.
	Oxy 8	44
	Oxy 8	44
	Oxy 8	
	Oxy 8	
	Chlorine 36	
74 Muriatic acid	Chlorine 36	
	Chlorine 36	
	Hydrogen 1	9 water
	Hydrogen 1	9 water

The odour of this gas resembles burnt sugar. It has no acid properties. It destroys vegetable colours, is absorbed to a considerable extent by water when a red hot iron is introduced into a jar containing Protoxide of Chlorine, a violent explosion takes place & it has frequently been known to explode by the heat of the hand.

Its odour resembles burnt sugar. It has no acid properties. It destroys vegetable colours & is absorbed to a considerable extent by water. When a red hot iron is introduced into a jar containing protoxide of chlorine a violent explosion takes place & has frequently been known to explode by the heat of the hand.

Peroxide of Chlorine

This gas was discovered by Count Stadion of Vienna in 1815. It is formed by the action of sulphuric acid on Potash but is so extremely explosive, that a very small quantity must be made at a time. A grain or two of the chlorate of Potash may be placed in a glass tube & a few drops of sul. phuric acid poured on it. Put this over a spirit lamp & the deep green colour of the gas will indicate when the tube is full. It is much safer however to place it in hot water of a moderate temperature. When a spirit lamp is used, the tube must be made of light green glass about 3 inches long & ½ an inch in diameter. No cork is put in. The tube must be placed under a shade of wire, in order to retain the pieces of glass if it should give way & thick gloves must be placed on the hand that holds it. The explosion is very loud & a flash of light is at the same time produced.

Chloride of Nitrogen

This substance was dis-coverd in 1811 by M^r^ de Davy &
is the most explosive substance yet known. This compound
is formed by inverting a jar or wide mouthd bottle capa-
-ble of containing about 12 or 14 oz over a dilute solution of
the muriate of ammonia. Made by distolving an ounce
of the salt of ammonia & 10 or 12 oz of water. The bottle
is placed in a very shallow leaden cup, which rests on a
deep plate containing the solution previously heated
to the temperature of 90°. One portion of the Chlorine
forms the hydrogen of ammonia forming muriatic acid
& the other combining with the Nitrogen is converted into the
Chloride of Nitrogen (for Ammonia is composed of hydrogen &
Nitrogen) & the Chloride thus formed collects in the form of an oil
on the surface of the liquid & drops through it into the leaden
cup. An additional quantity of the liquid must be ready to
fill up the plate as the absorption of the chlorine proceeds.
Great care must be taken not to shake the bottle Any gaseous
or fatty matter must be removed by washing it with the
solution of Potassa before it is filled with chlorine. When
the oil has fallen into the leaden cup, the cup is cautiously
removed from the cup to the plate & the leaden cup taken
carefully away. The liquid remaining above the Chloride in the
cup is withdrawn by dipping a small piece of filtering paper into it
& touching the Chloride with a drop of olive oil on the the end of a
stick at least 2 or 3 feet long, a loud explosion ensues, though the
quantity of the Chloride does not exceed the bulk of a very small pea.

Phosphorus

for a knowledge of this curious substance, we are indebted to the celebrated Brande of Hamburg, who in the year 1699 accidentally discovered it in a visionary search for the philosopher's stone. This body was formerly obtained from urine when evaporated to dryness at a high temperature. The carbon of the animal matter decomposing the phosphoric acid, which it also contained. By adding a solution of nitrate of lead to it, phosphate of lead is precipitated, which yields phosphorus very readily when mixed with about $\frac{1}{4}$ part of its weight in charcoal & distilled in a retort. The easiest method however to obtain phosphorus, is from the decomposition of bones, which are combined of phosphate of lime & animal matter. The bones are to be calcined or ignited in any open fire until they become perfectly white. The animal matter flies off in the shape of carbonic acid gas & phosphate of lime remains. The calcined bones of which phosphate of lime constitutes nearly $\frac{4}{5}$ must be reduced to a fine powder & digested for a day or two with about $\frac{1}{2}$ their weight of sulphuric acid, & much water being added to the mixture, as to give it the consistence of a thin paste. The phosphate of lime is decomposed by the sulphuric acid & two new salts result, the insoluble sulphate of lime or plaster of Paris & the soluble biphosphate of lime. Pour boiling water upon the mixture & filter. The neutral sulphate is obtained & the solution of the bi-phosphate of lime is reduced. Evaporate the solution to the thickness of a syrup, add $\frac{1}{4}$ of its weight in charcoal; put the mixture into a retort

dapply heat. The phosphorus distills over. When first made it is often of a reddish brown colour & may be purified by passing it through Shamoy leather when liquid. It melts at 108° & sublimis at 550°.

Experiments

1/ Write with phosphorous on the wall, it becomes lu=minous in the dark.
2/ Boil phosphorus in water, the steam is luminous & the flame produced will render no body incandescent.
3/ <u>Phosphorescence of the Sea</u>. Dissolve phosphorus in boiling ether; pour a few drops on a lump of sugar & drop the sugar when thus saturated into hot water. the surface of the wa=ter will become luminous exhibiting the phosphorescence of the sea.
4/ Boil phosphorus in water: shake the flask & luminous sparks will appear on the side & resembling stars.
5/ Dissolve phosphorus in oil & pour out the cork; the bot=tle will become luminous.
6/ Phosphorus may be inflamed under water by droping a steam of oxygen upon it. The water however must be boiling.
7/ Take some slicks of phosphorus & put upon them some Iodine. The phosphorus becomes incandescent.
8/ Place phosphorus upon slate & touch it with a knife which has been rubbed upon a peice of wood. the phos=phorus immediately inflames.
9/ Take a few grains of chlorate of potash. place in them a small peice of dry phosphorus rap them up tightly in paper & strike them with a hammer; an explosion is pro=duced.
10/ Mix phosphorus & chlorate of potash together pour water on

in them by means of a pipet, using sulphuric acid of in con-
=tact with the mixture. Euchlorine or Peroxide of Chlorine is
formed which sets fire to the Phosphorus.

11. Canton's Phosphorus or Solar Phosphorus is made by cal-
=cining oyster shells in an open fire for about ½ an hour
after which the whitest & largest pieces are selected, mixed
with about ⅓ their weight of flowers of sulphur powdered and into
a crucible with a closely luted cover & heated red hot for an
hour. When the crucible has become quite cold, select the
whitest pieces of its contents for use. Then bring it into the
dark & it will shine for a considerable time.

12. Take 2 pieces of lump sugar & rub them in the dark
& they become phosphorescent.

13. Wilson's Phosphorus. Select a dozen oyster shells - the
deep are the better. Then take most of the flaming coals
but not all from a fire that is burning briskly - throw the
shells over the surface & replace the coals that have been taken
off. In about an hour's time take out the calcined shells
observing to break them as little as possible after exposing
them for a few minutes to the light, they will be found to
have acquired a high degree of phosphorescence glowing in
the dark with most of the prismatic colours. It is not how-
=ever necessary that the shells should be calcined in the
open fire for if they are heated sufficiently in a crucible
they will exhibit prismatic colours chiefly blue & green
though not so bright as by the former method. If the
calcination is effected in an iron crucible, all those part
of the shell that have been in contact with the metal
glow with a red light. Phosphorus will be much brighter
if pieces of charcoal shell are mixed with it & even better if
pieces of charcoal

Phosphorus from Heat. There are many substances which be-
=come luminous, when moderately heated that is

to say at a temperature below red heat. These are very nu:
:merous; phosphates of lime found near Ethamadura in
Spain becomes luminous when subjected to heat as also
fluor spar. carbonate of lime called Swinston Quarry
Some specimens of heavy spar.

15/. Bodies which are spontaneously phosphorescent.
The flesh of certain fresh & salt water fish. of these the
tench, carp herring & sole become phosphorescent previous
to putrefaction. The fish should be gutted & split & the
scales scraped off & put in a dark cellar when they shine
before 24 hours. Phosphorescence is rarely found in the flesh
of quadrupeds & never in that of birds. The phosphorescence
of the sea. is caused by small marine insects - The
Common 100 legged worm exhibits this when irritated -
In the vegetable world phosphorescence is less common.
A few flowers have been known to give it out on a fine
night

16/ Let a small piece of phosphorus be scraped to free it
from any oxide & dried by immersion in alcohol. Pass
a thread through it with a needle & suspend it in a solu:
:tion of nitro-muriate of gold. In a few minutes it will
be covered with pure gold.

17/ Suspend the same in a solution of sulphate of copper; that
metal is deposited & in nitrate of silver. silver will be after
a day or two.

In these precipitations Phosphoric acid is ~~decomposed~~ formed.
The acids are set free. the metals deposited. If a pen be dipped
in water & then plunged into phosphuretted ether, at the mo:
:ment of contact of the two fluids, a sudden light spreads through
the air & occasionally flashes of light issue from time to time
out of the mouth of the jar.

A glow worm emits much more light than usual in oxygen-gas.
Kerp's phosphorus. Mix sulphuret of antimony, iron filings & nitre
together in a crucible & apply heat. The contents will be phosphores.

Phosphuretic Hydrogen

This gas is moderately procured by taking 40 grains of phosphorus 50 of Caustic potassa to 60 drops of water. A very gentle heat must be applied. because the atmospheric air in the Retort must be consumed by detonation before the gas is evolved. The beak of the Retort must be put into the water cautiously to prevent the water from entering into the Retort at the time of the detonations. This gas is so combustible as to take fire, whenever it comes in Contact with atmospheric air. The herculianity of this gas. is the dense rings of smoke that ascend, when a bubble of the gas explodes.

Experiments

1/ Place a jar containing oxygen gas on the shelf of the pneumatic trough. Allow a single bubble of phosphuretted hydrogen to enter. Very vivid light is produced. In this experiment. care must be taken to prevent. the phosphuretted hydrogen from accumulating or the explosion will be so violent as to break the glass.

Cyanogen.

This body was discovered by Gayelsack and was called Cyanogen from its being one of the essential engredients in the Ferro-Cyanide of Iron (Prussian Blue). It is obtained in the gaseous form by exposing the bi-cyanide of Mercury to heat in a

glass retort. The bi-cyanide of mercury is itself obtained by boiling 8 parts of prussian blue 11 of the peroxide of mercury & 30 of water in an earthen evaporating basin for 10 or 15 minutes. Add water; filter & evaporate & crystals of the bi-cyanide of mercury will be obtained. Cyanogen gas is colourless, it does not support combustion, but burns with a purple flame. It is transparent. It has a peculiarly pungent odour.

Hydro-Cyanic or Prussic Acid

Prussic acid was discovered in 1782 by Scheele. Soubeiran proposes the following process as affording the most abundant produce of prussic acid. It consists in filing a narrow tube placed horizontally, with fragments of the Cyanurate of Mercury & causing a current of sulphuretted hydrogen gas to pass slowly along it. The instant the gas comes in contact with the cyanurate, double decomposition ensues & hydro-cyanic acid & the black sulphate of mercury are generated. The progress of the sulphuretted hydrogen along the tube may be distinctly traced by the change of colour & the experiment may be closed as soon as the cyanurate has become black. Pure hydrocyanic is a pale colourless fluid having a strong odour like that of peach blossoms. It excites at first a sensation of coolness on the tongue, which is soon followed by heat, but when diluted, has the flavour of bitter almonds. Pure hydro-cyanic acid is a powerful poison. Twenty five drops placed on the tongue of a dog causes death in a very few seconds. and small animals, when confined in its vapour are very rapidly destroyed. On inspiring this vapour diluted with atmospheric air, headache & giddiness supervene. The best antidote after taking this acid is a cold effusion.

Cyanic acid or Fulminating Mercury.

Take 100 grains of mercury. Dissolve them in an oz & ½ measure of nitric acid. add 2oz of spirits of wine & gently heat: the fulminating mercury in the form of powder falls to the bottom. Of this substance fulminating carry caps are formed. It may be exploded by wrapping a small quantity up in paper & striking it smartly with a hammer or exposing it to a gentle heat.

Carbon

This substance has a very wide distribution in the world around us. Through the atmosphere it exists in the shape of Carbonic acid gas. & of every vegetable. & animal product it forms a chief constituent. Coal is almost pure carbon. It exists in chalk & marble & in plumbago. & diamond is almost pure carbon. In fermented liquors carbon exists & perhaps the finest species is procured by passing alcohol or turpentine through red hot tubes. To obtain carbon on a large scale, carbon wood is piled up & covered with earth except a few air holes which are left to produce the combustion. The charcoal used in the preparation of gunpowder is procured by reducing wood to low

in iron cylinders, when the charcoal of the wood remains. The charcoal used by the chemist is obtained by placing wood in a crucible, covering it with sand & exposing it to a high heat. Animal charcoal is made by treating animal substances in the same manner. Lamp black is the soot obtained by burning resinous substances such as oil, tallow, &c. Charcoal deprives substances of their colour taste & smell. A cask charred in the middle keeps water long sweet. Meat surrounded by charcoal powder again becomes sweet if it has been tainted. From 2 other varieties of sodden spirits which are distinguished from peculiar odour & flavour be macerated in powdered charcoal, they lose both their colour taste & smell. Vinegar, cider, other liquors & putrid substances dissolved or suspended in water containing charcoal lose their colour in like manner. Syrups & other saline substances may be rendered colourless. For filtering purposes animal charcoal or what is called ivory black is used. Such is a mixture of charcoal & phosphate of lime obtained by burning bones. Charcoal gives a great heat & no smoke is produced. When it is burned in oxygen the volume is not increased. A diamond can be burnt in oxygen, thus realizing the opinion of Newton. If well pounded charcoal brought to a red heat in a crucible, nitre & will be deflagrated, & a shower of sparks will be thrown out. For the powerful affinity of carbon for oxygen, it is much used for reducing or deoxidizing metals. With oxygen it forms carbonic oxide & carbonic acid. It unites with hydrogen forming carbonated hydrogen, the gas used for lighting streets. With nitrogen it forms Cyanogen, the base of Prussic acid. It is used in the preparation of iron & steel. And the composition of Gunpowder & it forms the basis of Prussic acid. Red paint & drawing ink. Red hot charcoal & white ashes & potash, which are readily soluble by sulphuric acid, while animal charcoal are very sparingly affected by the acid. The compound with it is of a very different state. Charcoal in

is a bad conductor of heat. It is employed to cover vessels intended to retain heat.

Carbonic Oxide

This gas is inflammable. It is very easily procured by exposing dried chalk to heat with iron filings in an iron retort. Equal proportions of chalk & iron filings must be taken & the heat must be very speedily raised. This gas detonates feebly with oxygen gas & is very fatal to animal life. In collecting this gas, the water ought to be whitened with lime to absorb any carbonic acid that passes over.

Carbonic Acid

This gas was discovered by Dr Black of Edinburgh the celebrated propounder of the theory of latent heat. This gas may be obtained from any of the carbonates by means of heat, but more readily with acids. Take a few pieces of marble; put them into the retort & pour over them very dilute muriatic acid. A violent effervescence ensues & carbonic acid gas is eliminated. This gas is transparent & colourless & is formed during respiration & combustion. It is so heavy, that if poured into a vessel upon a candle placed in it, it will extinguish it. In the grotto D'Etrave it is found five to the depth of 18 inches; & that dogs are killed & men escape. It is often dangerous to go into brewers vats & cellars & pits on account of the presence of this gas. If a candle is not extinguished in them however it is safe. In coal-pits it is set free & then called fire-damp. When combined with common air, it explodes violently; but when diluted with 3 or 4 times its bulk of air it is respirable, but produces narcotic

effects. It is from the presence of this gas that some liquors sparkle & effervesce & it is from the same cause that they exhilarate when taken into the stomach. The pungency of soda water & ale is produced by carbonic acid & when it escapes by exposure to the air, these liquors become stale. Water by boiling looses its carbonic acid & hence is rendered insipid. This gas is highly antiseptic; for a piece of meat enclosed in a vessel containing it keeps far longer than in atmospheric air. Yeast poultice is indebted to its anti-septic powers to carbonic acid gas being evolved & it has been asserted that fevers and other infections in the neighbourhood of lime kilns, when water absorbs this gas it bubbles like champagne, or in other words forms soda water." Medicinal water can be made by shaking water in a bottle containing this gas. The atmosphere contains $\frac{1}{200}$ of this gas; the springs of Tunbridge, Piedmont, & Carlsbad are highly charged with it & it is found in combination with many substances forming rocks. When a large soap bubble filled with common air, is let fall into a wide glass containing carbonic acid gas, the bubble rebounds like a football & appears to rest on nothing.

Light Carburetted Hydrogen

In the year 1733, some fire damp was collected & exhibited before the Royal Society in London, & in the same year Dr Clayton discovered the gas which is produced during the distillation of pit coal & showed its combustibility. This gas is found also in stagnant pools by the decomposition of vegetable matter. By stirring the mud, a vessel may be filled with it. But whether it be procured in this manner or from a coal pit, it contains about $\frac{1}{20}$ of carbonic acid of which it may be freed by passing the gas through lime water or a solution of Potash. This gas has neither taste nor smell when pure. It will neither support combustion or respiration & is partially absorbable by water. It is highly inflammable & if a jet of it is set on fire, it burns with a yellow flame. Several chemists [illegible] than hydrogen. The products

of the combustion are Carbonic acid & water. Whatever may come into contact with any other body - if that body be readily combustible.

Olefiant Gas or Hydruret of Carbon

This gas was discovered in 1795 by some dutch Chemists, who gave it the name of olefiant gas from its property of forming an oily liquid with Chlorine. To obtain this gas, 1 part of alcohol with 3 of strong sulphuric acid must be mixed together in a glass retort & the fluid must not be filled more than ⅓ full.

Alcohol 23 { hydrogen . . ; 7 olefiant gas
1 do . . . ; 7 do
1 do . . .
carbon. 6
do 6.
8 oxygen . . . 9 water

From exposing resinous & fatty substances to a red heat in a close vessel, a great quantity of this gas & other compounds of Hydrogen may be procured. But in this manner that oil gas is prepared on a large scale, which owes its great illuminating power principally to the quantity of olefiant gas, which it contains. To obtain oil gas, the oil must be dropped into a red hot tube by the heat the oil is decomposed olefiant gas passed off. It contains no sulphuretted hydrogen, possesses one purification & therefore more fitted for lighting houses than other gas. Oil gas gives twice as much light as coal gas, but is 3 times as dear.

Experiments.

1st If 1 of olefiant gas & 2 of Chlorine be mixed together & a light be applied, it will burn quickly & a great quantity of carbon is deposited.

2d Mix chlorine & olefiant gas together for a short time & they will remain except in an oily substance.
Light carburetted Hydrogen & Chlorine do not exist except in the light; but olefiant & Chlorine do. Hence we have a method of separating olefiant gas from light carburetted H. The more olefiant gas, the coal gas contains, the better it is.

Sulphur

This substance is found in volcanic countries in combination with a vast number of metals & minerals, Iron Pyrites & Copper Pyrites, Zinc or Blende, &. Galena are sulphurets of their respective metals. From Sicily & Italy quantities of sulphur are imported, but by Exposing iron pyrites to heat in close vessels, a great quantity of the sulphur of commerce is procured. Sulphur is a brittle solid of a greenish yellow, with a peculiar odour when rubbed. When its specific gravity is 1.99; at the temperature of 190° Fah; it liquifies at 220°, it is in a state of perfect fusion if then poured into cylindrical moulds, forms the roll sulphur of commerce. When exposed to a greater heat than 220°, instead of becoming more fluid, it becomes more tenacious at 450°, the vessel containing it may be inverted, without any sulphur falling out, by a further increase of temperature, it becomes more fluid again if then poured into cold water it forms a soft tenacious, ductile mass quite transparent. Mr Faraday with it formed his beautiful collection of transparent specimens of antique gems. When 1 oz lb of sulphur are melted in an earthen crucible, & the crucible be inverted after making a hole in the crust that immediately forms on the melted sulphur to let it escape, large crystals of sulphur are procured. Common stick sulphur has a crystalline texture. Sulphur is very volatile. It begins to rise slowly in vapour, even before it is completely fused. At 550 or 600° of Fahrenheit, it volatilizes rapidly & again condenses. It is thus that flowers of sulphur are produced. Sulphur is insoluble in water, but is easily dissolved in boiling turpentine or alcohol. Sulphur burns freely in the open air; but more so in Oxygen gas forming sulphurous acid gas.

Sulphurious acid

Sulphurious acid was first discovered by Priestly. It is colourless & transparent. It may be obtained by burning sulphur in oxygen or much more easily by passing sulphuric acid on mercury & collecting what passes may be collected by displacement as its specific gravity is double that of Oxygen. (2·2222) It is converted into a fluid, when exposed to a pressure of two atmospheres (30 ℔ to a sq: inch) It is also obtained liquid, when the vessel that receives it, is surrounded by a freezing mixture of salt & snow. It extremely volatile, boiling at 14° of Fahrenheit, & hence its evaporation causes intense cold. When a jar is filled with sulphurous acid gas & placed over water, the water rushes up with explosive violence. This gas is a suffocating pungent smell: it distinguishes burning bodies it fatal to animals. It also contains considerable bleaching properties. In the manufacture of straw bonnets, the straw is bleached by means of the fumes of sulphurous acid gas.

Sulphuric acid

This acid was discovered by Basil Valentine towards the end of the 15th century. To obtain sulphuric acid, sulphur & ⅛ of Salt-petre must be burned together & the fumes condensed into leaden chambers having water. The fumes are absorbed & the water is impregnated with sulphuric acid. The formation of sulphuric acid may easily be exemplified as follows; into a small retort put 400 grains of mercury & 600 of sulphuric acid & into another copper filings; heat the first retort & then sulphurous acid gas will pass off & pour the copper filings, pour sulphuric acid & dilute nitric acid. Heat this retort

also a deutoxide of Nitrogen will be evolved. When these gases come together in a large receiver, a crystalline compound is deposited on the sides of the receiver in beautiful dentritical crystals. If into the vessel water be poured, a brisk effervescence ensues. Nitrous acid fumes arise, & the water absorbs the sulphuric acid. The test of sulphuric acid is muriate of Barytes, which forms with it a precipitate entirely insoluble.

Sulphuretted Hydrogen

This gas is easily procured by pouring muriatic acid over sulphuret of Antimony. This gas is extremely noxious & more dies in air containing 150 part of its bulk of this gas; dogs in 800 & birds in 1500. By putting birds or small animals into bladders containing this gas with their heads out, they soon die. It burns with a pale blue lambent flame. This gas is absorbed by water & the waters of Harrowgate & Boroughbridge are plentifully impregnated with sulphuretted Hydrogen. This gas is of singular use in testing metals. When any of this gas sulphuretted Hydrogen with salts of Gold forms a yellow precipitate

"	"	Platina	" Metallic "
"	"	Silver	" black "
"	"	Mercury	" black "
"	"	Tolybdena	" brown "
"	"	Copper	" black "
"	"	Tin	" brown "
"	"	Lead	" black "
"	"	Zinc	" whitish yellow
"	"	Bismuth	" black "
"	"	Antimony	" orange "
"	"	Arsenic	" yellow "

Boron

Sir H. Davy who discovered Boron in 1807, prepared it by subnitting Boracic acid a compound of Boron & Oxygen to the action of a galvanic battery. It is a dark olive coloured substance, which has neither taste nor smell. It is a non conductor of electricity. It is insoluble in water, alcohol, ether & oils.

Boracic Acid

This is the only known compound of Boron & Oxygen. It is a natural product it is found in the hot springs of Lipari Islands of Sasso in the Florentine territory. It is a constituent of several minerals of which the Silicate & Boracite may be mentioned. It occurs mixed mineralogically under the form of Borax a native compound of Boracic acid & Soda. It is prepared for chemical purposes by adding Sulphuric acid to concentrated solution of purified Borax & boiling water till the liquid acquiring a distinct acid reaction, the Sulphuric acid unites with the Soda forming glauber salts & the Boracic acid is deposited, when the solution cools in a confused group of crystals, which are sometimes scaly & sometimes adherent. The form of pure, triclinic prisms. It is then thrown into a filter & edulcorated with cold water till the Sulphate of soda & traces of Sulphuric acid are entirely removed.
Experiment. Take. Boracic acid. dehydrate it & in boiling alcohol the light is intensely green.

Ammonia

The spirits of hartshorn have been long familiar to chemists, but the existence of ammonia as a gas was first discovered by Priestly who described by them in his works under the name of alkaline air. It is sometimes called the volatile alkali, but the terms Ammonia & Ammoniacal gas are more frequently employed. The term Ammon is derived from the temple of Jupiter Ammon in North Africa. The most convenient method of preparing Ammoniacal gas for the purposes of experiment is, to by applying a gentle heat to the concentrated solution of Ammonia contained in a glass vessel. It soon enters into ebullition & a large quantity of Ammonia is disengaged. This gas may easily be obtained by displacement. Ammoniacal gas is much lighter than atmospheric air & therefore the vessel intended to contain it must be placed with its mouth downwards. The test of Ammoniacal gas is muriatic acid gas, which produces with it dense white fumes. Ammonia is a colourless gas which has a strong pungent & suffocating power upon the eyes & nose. It is quite irrespirable in its pure form, but when diluted with air it may be taken into the lungs with safety. It is not combustible nor a supporter of combustion. It possesses powerful alkaline properties. Ammonia is a compound of Nitrogen & Hydrogen.

N.B Though simple & caustic alkalies are Boron & Silicium, besides they are of no practical utility we shall leave them over in silence.

It was published: "All non-metallic bodies (then com-
bining proportions) are as follows:

No		C. P.
I	Hydrogen	1.
II	Carbon	6.
III	Oxygen	8.
IV	Phosphorus	10.
V	Chlorine	30.
VI	Selenium	40.
VII	Boron	5.
VIII	Nitrogen	14.
IX	Sulphur	16.
X	Bromine	75.
XI	Iodine	124.
XII	Fluorine	unknown.

—

Cyanogen is a compound of Carbon & Nitrogen
Ammonia . . . Nitrogen & Hydrogen
Xanthogen . . . Carbon & Sulphur.

General Properties of

METALS

Metals are distinguished from other substances by the following properties;

I. They are all positive electrics

II. They are all conductors of electricity & calorie.

III. They are in general good reflectors of light.

IV. They possess a peculiar lustre, called Metallic lustre.

The following table exhibits the names of the metals, their discoverers & the year in which they were discovered.

I.	Gold	known to the ancients.		
II.	Silver			
III	Iron			
IV.	Copper			
V.	Mercury			
VI	Lead			
VII	Tin			
VIII.	Antimony	first described by	Basil Valentine	15th century
IX.	Zinc	" " "	Agricola	1520.
X.	Bismuth	" " "	Paracelsus	16th century
XI.	Arsenic	first discovered by	Brandt	1733
XII.	Cobalt			
XIII.	Platinum	" " "	Wood of Jamaica	1741.
XIV.	Nickel	" " "	Cronstedt	1751.
XV.	Manganese	" " "	Gahn & Scheele	1774.
XVI	Tungsten	" " "	A. & D'Elhuyart	1781.
XVII	Tellurium	" " "	Müller	1782.
XVIII	Molybdenum	" " "	Hielm	1782.
XIX	Uranium	" " "	Klaproth	1789.
XX	Titanium	" " "	Gregor	1791.
XXI	Chromium	" " "	Vanquelin	1797.
XXII	Columbium	" " "	Hatchett	1802
XXIII	Palladium	" " "	Dr Wollaston	1803
XXIV	Rhodium			
XXV	Iridium	" " "	Descotils & Smithson Tennant	1803

XXII. Cerium	first discovered	by	Hisinger & Berzelius.	1804.
XXIII. Osmium	"	"	" Smithson Tennant	1803.
XXIV. Potassium				
XXIX. Sodium				
XXX. Barium			Sir H. Davy	1807
XXXI. Strontium				
XXXII. Calcium				
XXXIII. Cadmium	"	"	" Stromeijer	1818
XXXIV. Lithium	"	"	" Arfwedson	1818
XXXV. Silicium	"		" Berzelius	1824.
XXXVI. Zirconium				

Most of the metals are remarkable for their specific gravity. A high specific gravity was once considered as an essential character of metals; but the discovery of Potassium overthrew such an opinion.

The following table exemplifies the specific gravity of the respective metals, in order, with the names of the persons who ascertained them.

	Sp. Gr.	
Platinum	20·98	Brisson
Gold	19·257	do.
Tungsten	17·6	D'Elhuyart
Mercury	13·568	Brisson
Palladium	11·3–11·8	Wollaston
Lead	11·352	Brisson
Silver	10·474	Brisson
Bismuth	9·822	Brisson
Uranium	9·000	Bucholz
Copper	8·895	Hatchett
Cadmium	8·604	Stromeijer
Cobalt	8·538	Haüy
Arsenic	8·308	Bergmann
Nickel	8·279	Richter
Iron	7·788	Briston
Molybdenum	7·4	Hielm
Tin	7·291	Brisson
Zinc	6·861–7·1	Brisson
Manganese	6·85	Bergmann
Antimony	6·702	Brisson
Tellurium	6·115	Klaproth
Titanium	5·3	Wollaston
Cerium	4·89–4·69	Hisinger & Berzelius
Sodium	0·9972	Gal-Lussac & Thenard
Potassium	0·865	Thenard

The malleable metals are Gold, Silver, Copper, Tin, Platinum, Palladium, Cadmium, Lead, Zinc, Iron, Nickel, Potassium Sodium, Mercury, Lithium. The other metals are only malleable in a small degree, or like Antimony, Arsenic & Bismuth are actually brittle. Gold surpasses all metals in malleability. One grain may be extended so as to cover 52 square inches of surface & have a thickness not above 282020 part of an inch.

Nearly all the malleable metals are ductile. Those which possess their quality in a high degree are Platinum, Gold, Silver, Iron & Copper. Dr Wollaston obtained Gold wire $\frac{1}{5000}$ of an inch in diameter & Platinum wire $\frac{1}{30,000}$ of an inch. Iron can be drawn into fine wire, but cannot be made into leaves. The order of metals with regard to tenacity is as follows: (the diameter of each wire was 0·787 of a line a line being $\frac{1}{12}$ of an inch.)

Iron	lbs/sq.ins	549·25
Copper	"	302·278
Platinum	"	274·32
Silver	"	187·137
Gold	"	150·753
Zinc	"	109·54
Tin	"	34·63
Lead	"	27·621.

Iron & Copper are the most tenacious of the metals. Many of the metals have a distinct crystalline texture. Iron & Platinum Bismuth Zinc & Antimony laminate. Metals are sometimes obtained in crystals, which are of the form of the cube the regular octahedron, or some other allied to it.

The conducting power is different in different metals. Silver is the best conductor; then Gold, Tin; Copper, which are nearly equal & last of all Iron, Platinum & Lead.

The metals with the exception of mercury are solid at common temperatures, but they may all be liquified by means of heat.

There are two divisions of metals: I, Those fusible below a Red heat (i.e. 700°) – II. Those infusible at a Red heat.

I. Those fusible below a Red heat.

Mercury	fusible at	39°	ascertained by	
Potassium	" "	136°	"	Gay-Lussac & Thenard.
Sodium	" "	190°		
Tin	" "	430°	"	Newton.
Bismuth	" "	493°		
Lead	" "	500°	"	Biot.
Tellurium	" "	Earthen Ers than Lead	"	Klaproth
Arsenic	" "	undetermined	"	
Zinc	" "	698°	"	Brogniart
Antimony	" "	a little below red heat	"	
Cadmium	" "	at a Red heat	"	Stromeyer

II. Those infusible at a red heat.
(By Pyrometer of Wedgewood.)

Silver	" "	20°	" Kennedy.
Copper	" "	27°	" Wedgewood.
Gold	" "	32°	
Cobalt	"	Earthen more fusible than Iron	"
Iron	"	130°	
Manganese	"	" 160°	
Nickel	"	" do;	

Palladium, Molybdenum, Uranium, Tungsten, Chromium — Fusible before the oxy-hydrogen Blowpipe & slightly affected by a Smith's forge.

Titanium, Platinum, Columbium — Infusible at the heat of a Smith's forge; but fusible by an oxy-hydrogen blow-pipe.

The metals differ also in volatility. Some are readily volatilized as Cadmium, Mercury, Arsenic, Tellurium, Potassium, Sodium, Lead & Zinc.

Metals are divided by M. Thenard & Henry of Manchester. in-
-to two classes

Class I. Metals, which the oxides of which cannot be redu-
-ced to the metallic state by the sole action of heat.

Class II. Metals, whose oxides are reducible by heat only.

Class I.

The metals of the first class were formerly called "Base or Imperfect metals", in contradistinction to Gold, Silver & Mer-
-cury, which were termed "The noble or perfect metals". As the metals contained in this class are numerous, and differ from one another in their degree of affinity for oxygen, they may be divided into 4 orders.

Order I. Metals which decompose water at common tem-
-peratures. They are 6 in number;

Potassium,	Sodium,	Lithium.
Barium,	Strontium,	Calcium.

The protoxides of the first 3 metals are distinguished by their causticity & solubility in water, & by possessing alkaline properties in an eminent degree. They are called "Alkalis" & their metallic bases are frequently termed "Al-
-kaline metals". The protoxides of Barium, Strontium & Calcium are commonly denominated "Alkaline earths," because although they have the acrid taste, & the alkaline reaction of the former alkalis: they approach both in their appearance & in their sparing solubility in wa-
-ter to the more alkalious nature of the earths.

Order II Metals which are supposed to be analogous to the former, but the exact nature of which has not been determined. They are 6 in number;

Magnesium,	Yttrium,	Zirconium
Glucinum,	Aluminum.	Silicum.

The oxides of these metals have a white colour & an ear-
-thy aspect, are very sparingly soluble in water. They are called "earths."

Order III Metals which do not decompose water at any temperature. Of these there are 15 in number viz;

Arsenic, Uranium, Titanium.
Molybdenum, Columbium, Bismuth.
Chromium, Nickel, Copper
Tungsten, Cobalt, Tellurium.
Antimony, Cerium, Lead.

Order: II. Metals which decompose Water at a Red heat
They are 5 in number;

Manganese, Iron, Cadmium
Zinc, Tin.

—

Class. II.

This class only comprises 5 metals, the oxides of which are decomposed by a red heat. They are

Mercury, Platinum, Silver
Palladium, Iridium, Gold.
Osmium, Iridium.

Potassium

This metal was discovered by Sir Humphrey Davy in 1807. It was prepared by causing Hydrate of Potassa slightly moistened for the purpose of increasing its conducting power, to communicate with the opposite poles of a Galvanic battery of 200 plates, when the oxygen both of the water & the Potassa passed over to the positive pole, while the Hydrogen of the former & the Potassium of the latter made their appearance at the negative. - It is now prepared by mixing dry Carbonate of Potassa, iron filings & Charcoal in an iron bottle & exposing it to a very high heat. From 8 ounces of fused Charcoal Carbonate of Potassa. 6 oz of iron filings, & 2 oz of Charcoal: 1 1/2 oz of Potassium result. Potassium is solid at the ordinary temperature of the atmosphere, at 70° it is fluid, & at 150 it melts. At 50° it is soft & malleable; at 32° it is brittle. It sublimes at a red heat without change, if atmospheric air be excluded. At 60° its density is 0.865, so that it is considerably lighter than water. It is quite opaque, & is a good conductor of electricity.

Experiments

1/ Put a small piece of Potassium with a pen-knife into water & it immediately disappears, on account of its affinity for Oxygen gas.

2/ Throw a piece of Potassium into a basin of water, the water is decomposed: the oxygen unites with part of the Potassium forming Potassa; & the Hydrogen, with another portion of the Potassium, forming Potassuretted Hydrogen, which is eschemically inflammable. The colour of the flame is rose-red.

3/ ~~Ice~~ Ice will have the same effect as water, in inflaming Potassium.

4/ Put 6 gr. of Iodine into a tube; put a gr. of Potassium upon it; heat & light result, & the Iodured of Potassa is formed.

Potassa or Potash. Oxide of Potassium

Potassium united with Oxygen in two proportions. The Protoxide commonly called Potassa or Potash, is always formed when Potassium is put into water, or when it is exposed to Oxygen gas. To prepare Potassa, dissolve Carbonate of Potassa in 4 times its weight of water, by rubbing it in an earthen mortar; mix the solution with a quantity of newly slaked Lime equal in weight to the Carbonate employed. Boil the mixture; filter; pure Potassa will pass through in solution while Carbonate of Lime will be retained. This from this solution that solid Potassa is usually formed. Evaporate the solution to dryness, fuse the mass that remains by a heat gradually increasing, till it flows like oil. Then pour it into moulds, & the fused Caustic Potassa of the different Pharmacopeias is obtained. This substance is an oxide of Potassium. It possesses highly alkaline properties; for if a little of the solution be poured into water tinged with a blue infusion of Cabbage, it immediately becomes of a fine green colour. Potassa is used in medicine as a caustic, & occasionally applied for internal diseases. With the basis of common soap, it forms glass with silica. The tests by which it is distinguished are the chloride of Platinum & Tartaric acid; the former gives a yellow and the latter a white precipitate.

Chloride of Potassium

Potassium takes fire spontaneously in an atmosphere of Chlorine, & burns with greater brilliancy than in oxygen gas; & Chloride of Potassium is the result. Oxygen gas is obtained from Chlorate of Potassa by heat, Chloride of Potassium remains. When a solution of the muriate of Potassa evaporates spontaneously, colourless cubic crystals of the Chloride of Potassium are deposited.

N.B. The Chlorides when dissolved become muriates, & muriates when dried, become Chlorides.

Iodide of Potassium

This compound is formed with emission of light when Potassium is heated in contact with Iodine. It may likewise be obtained by means of heat from the Iodate, Hydriodate of Potassa

Potassuretted Hydrogen

This compound is formed by placing Potassium on water. The water is decomposed; Oxygen of the water unites with one part of the Potassium forming Potassa; another portion of the Potassium unites with the hydrogen forming Potassuretted Hydrogen which is highly inflammable.

Sulphuret of Potassium

Sulphur unites readily with Potassium by the aid of heat; & so much calorii is evolved at the moment of combination, that the mass becomes incandescent. When put into water, heat is evolved, Sulphuretted hydrogen gas is set free.

Phosphuret of Potassium

This compound may be formed by the action of Potassium on Phosphorus, with the aid of a moderate heat. Phosphuretted Hydrogen is set free when this body is put into water.

Salts of Potassa or Potash

Nitrate of Potassa

This salt is generated spontaneously in the soil, & super-
-incumbent upon its surface in several parts of the world,
& especially in the East Indies; whence the greater part of
the nitre used in Britain is obtained. In France, & Germa-
-ny it is prepared artificially from a mixture of calc-
-areous earth with vegetable & animal remains contai-
-ning nitrogen. When a heap of these materials, preser-
-ved moist in a shady position, is moderately exposed
to the air, Nitric acid is gradually generated, & unites
with the Potassa, Lime & Magnesia, which are common-
-ly present in the mixture. On dissolving these salts in
water, & precipitating the two earths by Carbonate of Potas-
-sa, a solution is obtained, which yields crystals of Nitre
by evaporation. Nitre is always contaminated with com-
-mon salt. They are separated in a great measure by so-
-lution & crystallization; but it is almost impossible to
separate the whole of the salt. Nitre easily parts with part
of its oxygen, as may be seen in the preparation of oxy-
-gen gas. In the arts it is used principally for the prepa-
-ration of nitric acid, & Gunpowder & a number of fulmi-
-nating & deflagrating compounds. It easily melts
by exposure to heat, & when thrown into moulds in this state
so as to have the form of flat cakes or round balls, it forms
what is usually sold under the name of Sal-prunelle. This
salt obtains this name from the resemblance, it origi-
-nally bore to a plum, it having been usual to colour it pur-
-ple. Nitre is used for reducing a number of substances of
a metallic nature. In the East Indies, it is employed in
the preparation of cooling mixtures. An oz. of powdered
nitre, dissolved in 5 oz. of water, reduces its temperature
15 degrees. It possesses powerful antiseptic proper-
-ties, & is therefore much employed in the preservation
of meat, & animal matter in general.

By adding Nitric acid to a solution of Carbonate of Potassa. Evaporating it, crystals of nitre are obtained. The nitrate of Potassa is a colourless salt which crystallizes readily in 6 sided prisms. Its taste is saline accompanied with a coolness. It requires for solution, 7 parts of water at 60° Fahrenheit; 1 only its own weight of boiling water. It contains no water of crystallization, but its crystals are never quite free from water lodged mechanically within them. When heated, it deflagrates. The nitre of the ancients was soda.

Experiments.

To make match paper. Dissolve nitre in water, until it is saturated, wet brown paper with this solution, dry it & match paper is the result.

To make gunpowder. Mix intimately 300 grains of nitre, 60 of charcoal, & 40 of sulphur, previously reducing them to a fine powder. Here are the proportions of nitre, charcoal, & sulphur, in some of the best kinds of shooting powder; although the mixture cannot be made to have the same appearance without the appropriate machinery, it will be found to deflagrate somewhat in the same manner on applying a match, but not with the quick & sharp detonation which is observed only in gunpowder that has been properly manufactured.

To make Port fire. This is made with 3 parts of nitre, 2 of sulphur, & 1 of Gunpowder, well mixed & rammed in cases.

To make signal lights. Mix 600 gr. of nitre, 200 of sulphur, & 100 of the yellow sulphuret of antimony; put the mixture into a cone of paper, & touch it out-of-doors with a red hot iron. It deflagrates rapidly with a yellowish brilliant white flame.

To make a Blue light: Mix 100 or 200 gr. of the sulphuret of antimony with the same proportions of nitre & sulphur, & inflame it in the same manner. It deflagrates immediately with a vivid light, which is of a bluish tinge.

Sulphate of Potash

This salt crystallizes in 6 sided prisms terminated by 6 sided pyramids, which do not contain any water of crystallization. It is soluble in 16 parts of cold & 3 of boiling water. This salt is easily obtained from the residuum of the distillation of nitric acid, dissolving it in water & adding carbonate of Potassa till the excess of acid is completely neutralized & carbonic acid is evolved. Its taste is saline & bitter; the crystals are not affected by exposure to the atmosphere, but they decrepitate when heated & enter into fusion at a red heat.

Persulphate of Potash

This salt forms the residuum in the distillation of nitric acid or by dijesting the sulphate in strong nitric acid. It has a strong sour taste, reddens Litmus Paper & is very soluble in water.

Carbonate of Potash

This salt is very deliquescent & soluble in less than its weight of water. The pearl ashes of commerce is an impure Carbonate of Potassa, containing silicious matter & a little sulphate of Potassa & a small quantity of other salts. A solution sufficiently pure for ordinary experiments may be obtained by stirring it with 3 or 4 times its weight of cold water, the greater part of the other salts being left undissolved as they are less soluble than the carbonate. Carbonate Potassa so found is called in the shops salt of Tartar. A pure carbonate is obtained easily by decomposing the bi-tartrate by means of heat or by fusing the Carbonate in a Platinum Crucible
with flux. When equal weights of nitre & cream of tartar

are mixed together & thrown into a red-hot crucible, a rapid deflagration ensues & a white matter remains which is generally termed White-flux. It is a pure Carbonate. the nitric & Tartaric acids being completely decomposed & part of the Carbonic acid produced remaining in combination with the Potassa.

Black flux. If two parts of the bi-tartrate are mixed with 1 of nitre & the mixture is thrown in quickly & in successive portions into a red-hot crucible, which is covered by a lid, whenever the materials have been introduced a small aperture being left for the escapement of the gas, then a black mass remains in the crucible composed of Carbonate of Potassa & Charcoal. This salt must always be kept in close bottles to prevent its attracting water from the air. It is a test for Lemon Juice or infusion of Cabbage, green. Thus throwing its alkaline properties being much less caustic than pure Potassa, the colour remains for a much longer time. It is usually obtained in the form of an amorphous mass; but may be obtained in any form by fusion at a red heat.

Detonating Powder

Take 3 parts of nitre; 2 of Carbonate of Potass & 1 of Sulphur.

Bicarbonate of Potass

To obtain this salt transmit a stream of Carbonic acid acid through a solution of the Carbonate of Potassa. The solution should be evaporated by a very moderate heat. It crystallizes in 6 sided prisms. is not changed by exposure to the air & is used in effervescing draughts.

Effervescing draughts. Take 75 gr. of crystallized Tartaric acid & 76 gr. of Citric acid & 101 gr. of crystallized bi-carbonate of Potassa & a few pieces of Sugar. These proportions are sufficient to form 2 draughts. This is by far the most agreable & refreshing of all the effervescing draughts.

Ferrocyanate of Potass.

When dry animal matter, mixed with ½ its weight of Carbonate of Potassa is exposed for ½ an hour to a dull red heat having a small aperture to allow vapours to escape, a peculiar compound is formed which may be separated from the rest of the materials by water. The solution gives large yellow crystals. These crystals form the ferrosprussiate or ferro-cyanate of Potass &c. it is from these that Cyanogen is procured. This salt is soluble in 3 parts of water at 60° with own weight of boiling water. The crystals are large & of a beautiful yellow colour. They are not affected by exposure to the air, but become black when exposed to a red heat.

Impure Prussian blue. Prussian blue is manufactured in several parts of Great Britain. Equal parts of Carbonate of Potass & various animals substances such as hoofs &c. &c. heated red hot in large iron vessels. The fused mass is then ladled out into iron pans, where it concretes into solid blocks technically called metals. Upon these when cold 6 or 8 parts of water are poured, the solution is filtered & mixed with a liquor containing 2 parts of alum & 1 of green vitriol (sulphate of Iron) a precipitate falls, at first of a dingy green hue, but which by copious washing by very dilute muriatic acid acquires a fine blue tint. This is Prussian blue. In this process the animal matter furnishes the Prussic acid, which is a compound of Carbon, Nitrogen & Hydrogen. In order then to remove the Alumina from the Prussian blue, before forming ferrocyanate of Potash we should heat the Prussian blue of commerce with an equal weight of sulphuric acid which has been diluted with 5 or 6 parts of water, after wards wash it well with distilled water. It may then be powdered & added in successive portions to hot liquid Potassa pure until its colour ceases to be destroyed. The solution is then to be filtered evaporated & crystallized. The results the Prussiate of Potass of Commerce.

It is used as a test for metals, as it decomposes all metallic solutions except Gold & Platinum.
With solutions of Manganese. it forms a white precipitate

"	"	Deutox. of Iron	"	"	Clear blue
"	"	Tin	"	"	white " "
"	"	Antimony	"	"	white " "
"	"	Bismuth	"	"	white " "
"	"	Deutox. of Copper	"	"	brown " "
"	"	Deutox. of Mercury	"	"	white " "
"	"	Protox. of Iron	"	"	Copious white
"	"	Tritox. of Iron	"	"	Copious dark blue
"	"	Zinc	"	"	white " "
"	"	Cobalt	"	"	Grass green "
"	"	Protox. of Copper	"	"	white " "
"	"	Lead	"	"	white " "
"	"	Silver	"	"	white becoming blue

Sulphocyanate of Potass

This salt is formed by mixing equal quantities of Prussiate of Potass previously reduced to powder & sulphur heating the compound in a crucible or porcelain capsul adding water & then filtering. The mixture must not be exposed to a very high heat it must be stirred all the time it is on the fire. It speedily takes fire & it ought to be exposed to heat for some time after the flame is extinguished. In this process the iron of the Ferrocyanic acid unites with sulphur forming sulphuret of iron & another portion of the sulphur joins with the cyanogen forming sulphocyanic acid; which combining with the Potass forms sulphocyanite of Potass. The sulphuret of iron being separated by filtration. This salt is the most delicate test of the ter salts of iron. With them it forms a red precipitate. The crystals are very deliquescent on exposure to the air & yield a neutral solution in water.

Acetate of Potass

This salt is obtained by adding purified acetic acid (vinegar) to Carbonate of Potass. It is sometimes used for pharmaceutical purposes by decomposing acetate of Lead by sulphate of Potass. The salt is of a white colour. The crystals are acicular. They contain 6 atoms of water & deliquesce rapidly on exposure to the air.

Tartrate of Potass

The neutral Tartrate formerly called soluble Tartar is formed by neutralizing the bi-tartrate with Carbonate of Potass. It crystallizes in four sided prisms which are very soluble in water.

Bitartrate of Potass

In impure form of this salt commonly known by the name of Argol or Tartar is found incrusted on the sides & bottoms of wine casks, a source from which all the Tartar of commerce is derived. This salt exists in the juice of the grape owing to its insolubility in alcohol is gradually deposited during the vinous fermentation. In its crude state when tinged with the colouring matter of the wine is called Argol or Tartar but when purified by solution & crystallization it constitutes the cream of Tartar of the shops. This salt is very sparingly soluble in water, requiring 60 times its weight of cold & 16 times of boiling water for solution. It is deposited from the latter in cooling in small crystalline grains. It has a sour taste & distinct acidulous action. The bitartrate of Potass is employed in the preparation of Tartaric acid & the other Tartrates. It is likewise used in preparing pure Carbonate of Potass. When exposed to a strong heat it yields an acid, impure oil & some pyrotartaric acid together with Carburetted hydrogen Carbonic acid & Carbonic oxide. The fixed products are Carbonate of Potass & charcoal, which may be separated from each other by solution & filtration. From this are the white & black flakes are prepared by processes formerly mentioned.

Chlorate of Potash

This salt maybe formed by transmitting chlorine through a solution of Potash. In this process water is decomposed. Its oxygen unites with one portion of the chlorine forming chloric acid, whilst its hydrogen unites with another portion & produces muriatic acid; hence chlorate & muriate of Po= =tash are extemporaneously generated & must be sepe= =rated by crystallization, which is easily effected be= =cause the chlorate is the first to crystallize.

It crystals are in shining romboidal plates. Its taste is cooling & pleasant. Its specific gravity is 2·0. Boiling water dissolves it; & on cooling off Potash Oxygen & Chloride of Potassium remains. From this salt are derived some of the most brilliant experiments in Chemistry.

I. Mix intimately Chlorate of Potash & flowers of sulphur & triturate them in a mortar, explosions will be pro= =duced.

II. Take a little of the salt contained in a tea= =spoon & strike it with a hammer, an explosion is produced.

III Take 4 grains of the salt & reduce it to powder, 2 grains of finely pulverized charcoal & 1 grain of sulphur. Form them together. They will speedily burst into flame.

IV Mix equal quantities of chlorate of Potash & sympa= =thic powder & drop upon them sulphuric acid. The mixture will be inflamed.

V Take one grain of the powdered salt, with ½ a grain of phosphorus. Wrap the mixture in a paper & strike it with a hammer. A violent detonation takes place.

VI Put into a glass 3 gr. of phosphorus & 6 chlorate of Potash & carefully fill the glass with water. & then convey to the bottom by means of a glass funnel sulphuric acid. The phospho= =rus immediately takes fire & burns vividly with a green light.

VII Mix chlorate of Potash & sugar & pour upon the mixture a few drops of sulphuric acid; the desired combustion immediately ensues.

VIII Pyrotechnians were made with a mixture of Chlorate of Potash & sugar coloured with vermilion. into this mix= =ture a small globe of glass containing sulphuric acid is

inserted, which when the tube is broken acts fire to the salt.

IX. Lucifers Mix equal parts of chlorate of Potass & sulphuret of antimony with gum water into a thin paste. Let a little of this paste be applied to each side of the end of a thin slip of wood already tipped with brimstone. This is inflamed by drawing it through sand-paper.

X. Red fire for theatres. Take 40 parts of dry nitrate of strontia: = ann 13 parts of finely powdered sulphur. 10 of nitre & 4 of sulphuret of antimony. The nitrate of strontium ought to be powdered separately & then mixed with the other substances previously powdered. Sometimes a little sulphuret of arsenic is added to the antimony & when the fire burns clear, finely powdered charcoal & lamp black will make it darker.

XI Green fire for Theatres. 13 parts of the flowers of sulphur 11 of nitrate of Barites 10 of nitre, 2 of metallic arsenic & 3 of charcoal.

Sodium

Sir H. Davy made the discovery of Sodium in 1807 a few days after the discovery of Potassium. Sodium is similar to Potassium in most of its properties. Put a piece of it the size of a pea into a cup of cold water it will not inflame. It is performed in a similar manner to it part by fusion galvanism, but may be procured by chemical process. Has to do at common temperature but to may be procured under the pressure of the finger. It fuses at 200° of Fahrenheit. It rises in vapour at a red heat. Its specific gravity is 0.9727. Its colour is dull. Combustion is always in hot than cold water. When it is thrown into water it takes fire but no combustion. It has a strong metallic lustre.

Oxides of Sodium

Chemists are only acquainted with 2 compounds of Oxygen and Sodium. The protoxide of Sodium is a greyish white solid, of a fetid offensive smell is obtained by burning Sodium in atmospheric air. It powders very highly alkaline & caustic properties. The peroxide which is of a yellow colour is obtained when Sodium is strongly heated in an excess of pure oxygen. When this latter body is dissolved in water, it is resolved into oxygen gas & pure soda. to

Soda or Protoxide of Sodium

The preparation of this body is exactly similar in exactly similar to that of caustic Potash & its properties is analogous to that body. Soda is however easily distinguished from Potash & the other alkalies by the following characters;

1. It yields with sulphuric acid a salt by its crystalline form easily recognised as Glauber salts or sulphate of soda.
2. All its salts are soluble in water & are not precipitated by any reagent. whereas solutions of Potash form the bitartrate, which is a dense precipitate.

3/ Precipitate its salts by means of platinum wire & the blow-pipe flame, they communicate to it a yellow colour.
4/ Bichloride of Platinum causes no precipitate with salts of soda whereas it gives a yellow do with those of Potassium.

Chloride of Sodium

usually called muriate of soda is common salt & exists in both animal & vegetable fluids abundantly, in the mineral kingdom forming many large beds & rock and several hundred cubic feet. (Hence Rock salt) from these sources it is named rock salt. It may be prepared also in large quantities from sea water of which it forms the principal saline ingredient. By evaporation Chemically it is obtained by crystallization in the cubic form & is then called sea salt or bay salt of commerce. In addition from northern regions where it is dissolved in large pans or boilers, occasionally a large portion of sulphate of soda separates when the temperature is very low. Part of the water freezing & the residue is a chloride of sodium from sea water is the most pure & obtained in large crystals. Common salt generally contains magnesia, which tends to render it deliquescent & its artificial properties are impaired. Its presence may however be easily detected by adding a solution of the carbonate of soda a white precipitate (carbonate of magnesia) which is insoluble in water. Sodium is obtained by Chlorine the same compound is formed. Dry salt decrepitates loud, when thrown into the fire from water being mechanically combined with it. Chlorine & soda combine & form a compound, which is much employed in solution as a disinfecting agent called La Barraque's do. Take 2800 gr. of crystallized carbonate of soda & dissolve them in 1.28 parts of water; pass Chlorine through this solution & the disinfecting agent is produced. As the compounds of soda are similar to those of Potassa, but are more easily dissolved in water. To see the greater affinity which Potassa has for the acids, pour a strong solution of this alkali into a saturated solution of sulphate of soda. Crystals of sulphate of Potassa fall to the bottom & soda remains in solution.

Sulphate of Soda

The sulphate of soda, commonly called Glauber's salt is occasionaly met with on the surface of the earth and is frequently contained in mineral springs. It may be made by the direct action of sulphuric acid on the carbonate of soda & is procured in large quantities as a residue in the process for forming muriatic acid. It crystallizes in prisms, which are soluble in about 3 parts of cold water at 56° & in less than ½ of their weight in water at 90°. An increase of temperature beyond this point only decreases their solubility. The crystals fuse with exposure to heat & effloresce, when exposed to the air.

Carbonate of Soda

The Carbonate of soda of commerce is obtained by lixiviating the ashes of sea-weed. The best variety is known by the name of barilla & is derived chiefly from the Salsola soda & Salicornia kalifera. The genus Salsola is said to have the quality of decomposing sea-salt & absorbing the soda, whence it acquires the name of salt-wort. Barilla is imported from Spain &c. the Levant in hard porous masses of a speckled brown colour. In this state it is contaminated with common salt. A very inferior kind of Carbonate of soda is manufactured in Scotland & called kelp. This is pure enough for making glass or soaps; but altogether unfitted for the Chemist. A purer Carbonate is formed by heating a mixture of sulphate of soda, charcoal & lime in a reverbatory furnace. By the action of the Carbonaceous matter, the sulphuric acid is decomposed; its sulphur being partly uniting with lime & partly dissipated in the form of sulphurous Acid gas, while the carbonic acid which is generated during the

process similar with the soda. The carbonate of soda is then obtained by lixiviation & evaporation. Also a very pure carbonate is procured by exposing the acetate of soda to a red heat; which is thus converted into carbonate of soda & charcoal. The former is separable by water.

Bicarbonate of Soda

This may be obtained by passing a current of carbonic acid through a solution of carbonate of soda. Its properties are exactly similar to those of bicarbonate of Potassa.

Sulphate of Soda

Of all the Alkaline phosphates, that with the base of soda is most usually employed owing to the facility with which it is obtained in crystals. It is prepared on a large scale in chemical manufactories by neutralizing the superphosphate of lime procured by the action of sulphuric acid upon burnt bones with carbonate of soda. The excess of phosphoric acid in the superphosphate combines with the soda of the carbonate & remains in solution, disengaging the carbonic acid with effervescence while the phosphate of lime losing its excess of acid becomes insoluble & precipitated. The phosphate of lime is separated by filtration & phosphate of soda is procured by filtration. Phosphate of soda is soluble in about 4 parts of water at 60° & 2 of boiling water. It has a saline taste without bitterness. When exposed to heat, its character is changed for it then gives a red precipitate with nitrate of silver, whereas phosphate of soda gives a yellow. Heat converts it into Pyrophosphate.

Nitrate of Soda

The nitrate of soda is obtained by saturating the carbonate of soda by nitric acid or by distilling common salt with $\frac{3}{4}$ its weight of nitric acid. It crystallizes in the form of rhomboidal prisms. Its properties are nearly similar to those of salt-petre. Professor Porter says that 3 parts of nitrate of soda with 1 of sulphur & 1 of charcoal will burn 3 times as long as powder & therefore recommends it in fire works.

Biborate of Soda

Biborate of soda or Borax is a natural compound found existing in some lakes in Tibet & Persia. The crude borax met with in commerce & known under the name of Tincal is refined by solution & crystallization. This salt crystallizes in prisms, which are soluble in 6 parts of boiling water & 20 of cold. When exposed to heat its water of crystallization is expelled & a transparent glass is obtained. It is principally employed as a flux.

ARITHMETIC

Barium

Barytas v. Barytes v. Oxide of Barium

Baryta is similar to lime in most of its properties, but it is much more soluble in water. Heat is evolved, when water is poured upon it, as happens when lime is slaked. The evolution of heat is caused by the water forming a hydrate with the Baryta. The salts of the Baryta are less soluble than those of lime. Baryta has an acrid taste & corrodes animal & vegetable substances; but its causticity is much inferior to that of Potassa or Soda. It attracts carbonic acid gas rapidly from the atmosphere & is converted into insoluble carbonate. It turns &c. a blue infusion of cabbage green & turmeric paper brown - & restores alkaline properties. All its salts are poisonous except the sulphate, which perhaps is caused by its insolubility. The most delicate test of Baryta is sulphuric acid, which forms with it a copious white precipitate. Lime water with sulphuric acid causes no precipitate.

Sulphate of Baryta.

{ From Redderense of the mineralogist }

This bodyexists in a state of nature & from it all the ba-
ryta of the chemist is obtained. It occurs massive, crystal-
lized, & columnar & granular. It is obtained artificially by
pouring sulphuric acid upon the carbonate or any other
salt of the baryta & when thus formed is used as a white
paint by artists. The method of obtaining Baryta from the
sulphate of Baryta is as follows. Make the sulphate red
hot & then throw it in water, which renders it easily
reduced to powder. Then mix it with ⅓ of its weight
of charcoal powder. Make the mass into a paste with
oil & expose it to a strong red heat in a furnace for
2 hours. A sulphuret of Barium results. By dissolving
this in water, the hydrosulphuret results, from which
all the salts of Barium can easily be obtained. Sulphate
of Baryta is distinguished from sulphate of lime or
Gypsum, with which it may be confounded by its
insolubility & by giving no precipitate with muriate
of Baryta.

Muriate of Baryta

This salt is obtained by pouring muriatic acid on the
hydrosulphuret or from the carbonate. It crystalizes
soluble in 3 parts of water at 60° & when exposed to a
red heat it is converted into Chloride of Barium.

Nitrate of Baryta

This is prepared by adding nitric acid to the hydrosulphure.
till it ceases to produce any effervescence, & till the
solution reddens slightly the vegetable blues. Sulphure-
ted hydrogen gas is evolved & from the carbonate by
pouring nitric acid upon it, carbonic acid gas being
evolved. It is soluble in 11 parts of cold & 3 of boiling
water. It crystallizes in octohedrons.

Carbonate of Baryta

Strontium

Strontia

Calcium

Oxide of Calcium or Lime

Muriate Lime. Lime is sparingly dissolved in water & the solution called lime water is formed by agitating lime in a bottle with water & separating off the excess of undissolved Lime as soon as the excess of lime has been deposited. It forms the most convenient of the Alkaline precipitants. Lime water & a precipitate of Carbonate of lime with Carbonic acid & by exposure to the air. Muriate of lime is soluble in water & alcohol. Muriatic acid gives no precipitate with lime water. Muriate of lime is soluble in an excess of Carbonate of potash & Ammonia. Sulphuric acid & sulphates throw down a precipitate with lime water. Oxalic acid & oxalates throw down a precipitate with lime water even when very dilute. Oxalate of lime is insoluble in water, Acetic acid, & Alkalies. Phosphoric acid & phosphates throw down a precipitate with lime water. Phosphate of lime is soluble in Muriatic acid. Nitric acid & nitrates throw down a precipitate with lime water. Nitrate of lime is soluble in water & alcohol.

Sulphate of lime

Sulphate of lime is formed by the action of dilute sulphuric acid on the Carbonate of lime, but as it is an important product of Nature, it is seldom prepared artificially. Gypsum, Selenite & Alabaster are all compounds of sulphate of lime & water. It is well known in commerce, as Plaster of Paris. When made to set this substance, the powder is mixed with Charcoal in alternate layers & heat is applied. The water is expelled & pure sulphate of lime remains. Sulphate of lime is used for making Casts & Moulds for printing & also when it lies in the stomach

is perfectly indigestable. Sulphate of Lime is soluble in 500 times its weight of water.

Phosphate of Lime

Phosphate of Lime is easily obtained by exposing bones to heat in an open fire. The animal matter flies off in the shape of carbonic acid gas & phosphate of Lime remains. From this substance phosphorus is procured by mixing it with charcoal & distilling.

Phosphuret of Calcium

Carbonate of Lime

Muriate of Lime

Chloride of Calcium

Chloride of Lime

II ORDER

Magnesian

Magnesia

Carbonate of Magnesium
v.
Subcarbonate of Magnesia

Bicarbonate of Magnesia

Aluminiferous

Alumina

This is one of the most abundant productions of nature. It is found in every region of the globe in rocks of all ages, being a constituent of the oldest primary mountains of the secondary strata & of the most recent alluvial deposites. The different kinds of Clay, of which so many useful earthenware are made consists of alumina, in a greater or less degree of purity. Though this common clay appears in beds sometimes mixed with pebbles & sand it is sometimes found beautifully crystallized. The ruby & the sapphire are almost entirely composed of alumina. Pure alum is obtained by adding ammonia to a solution of alum, which is a compound of sulphuric acid, alumina & Potash. This earth has no alkaline reaction, having no effect whatever on vegetable Colours. It has no taste nor smell but is altogether insoluble in water. Alumina adheres strongly to the tongue, on account of its great affinity for water. When it is mixed with water it is highly plastic and capable of being moulded into any form, hence its use in pottery. To ascertain that a piece of clay is good with all its properties. Pieces of clay, when used by Bridgewood are tried into the heat in his pyrometer, as their contraction was believed to indicate the degree of heat to which they were exposed.

Sulphate of Alumine & Potash

This important salt has been the subject of innumerable researches with regard to its fabrication & composition. Almost all the alum of commerce is factitious being extracted from various minerals called alum-ores or alum

Alder. The most extensive alum manufactory is at Hurlet near Paisley & the next to that at Whitby near Yorkshire. The aluminous Slate, which abounds in Sulphur, is submitted to a moistened combustion by which 180 tons of slate yield 1 ton of alum. The calcined mineral is dipisked in water, by which a ley is formed to which muriate of potash is added sometimes urine. After due concentration the liquor deposites crystals of alum. The theory in this process is the following; by the combustion of the sulphur sulphurous acid is formed, which united with the alumina of the slate forming sulphate of alumenia; but as this salt requires the assistance of an alkali to reduce it to crystals, muriate of potash is added for this purpose. Alum is soluble in about 3 parts of water at 60° Fah. or its weight of boiling water. Its taste is acid astringent.

A Receipt is easily prepared by mixing alum with sugar & exposing it to heat. 3 of alum & 1 of sugar do very well. 2 or 3 oz of the mixture should be boiled in a spirit flask over an open fire in an iron ladle, continuing the heat till most of the water of crystallization which the alum contains shall have been expelled & the mass have assumed such a consistence that it may be easily reduced to powder. It must be stirred constantly & with an iron rod or spatula. To prevent it adhering to the sides of the ladle. It is then reduced to powder & put into an iron retort & again exposed to heat. In a short time carbonic acid gas is evolved which burns with a blue flame. When no more gas ceases to be evolved, the mouth of the retort must be plugged with clay. When the retort cools, a little of the material may be placed on paper for when it will immediately become incandescent.

N.B. Alum is used to a great extent in dyeing as a mordant. (to render the colour permanent).

GLUCERIUM

Glucina

This body was discovered by Vauquelin in the emerald of Siberia. It is supposed to be the oxide of a metal, which would be called Glucinium, but which is not yet discovered. It is a white powder which has neither taste nor smell. It is quite insoluble in water. Its specific gravity is 3.0. The salts which are formed from it have a sweetish taste, a circumstance which distinguishes them from all others from which the base of Glucina is derived.

Yttrium

This is the supposed base of an earth, which was discovered in 1794 by Professor Gadolin in a mineral found at Ytterby in Sweden, from which it receives the name of Yttria. This earth resembles Alumina Glucina in its chemical properties, but it is distinguished from both by being insoluble in a solution of pure Potassa.

Zirconium

Zirconium was obtained in a satisfactory manner by Berzelius in 1824, by heating in a tube of Platinum, with the fluoid of Zirconia & Potassa, carefully dried in a tube of glass or iron, by means of a spirit lamp. The reduction takes place at a temperature below redness without evaporation of the K. The mass is then washed with boiling water & afterwards digested with a solution of dilute muriatic acid. The residue is pure Zirconium. When thus obtained, it is in the form of a black powder, which may be boiled in water without being oxidized. It is attacked with difficulty by the sulphuric, nitric, & nitro-muriatic acid, but is acted on readily by the fluoric.

Zirconia

Zirconia was discovered in 1789 by Klaproth, in the jar-
-gon or Zircon of Ceylon & has also been discovered in the hya-
-cinths found in France. Its colour is white & its di-
-stinguished from Glucina & Alumina, by being precipi-
-tated in all the pure alkalies, in an excess of which it
is insoluble.

Silicium :: Silicone

Pure silicium was obtained by Berzelius, in 1824 by
the action of Potassium & in fluo-silicic acid gas.
Silicium obtained in this manner has a dark mustard
colour without the least trace of metallic lustre; hence
it is doubtful whether it be a metal or not. Heat has
no effect on it, neither oxygen, nitric, muriatic
or fluoric acid effect it, but a mixture of fluoric
& nitric dissolves it readily.

Oxide of Silicium or Silica

Silex or Silica exists in the earth in great quantities
It enters into the composition of most of the earthy mine-
-rals & stones under the name of Quartz rock, it
forms independant mountain masses. It is the
chief ingredient in Sandstone, Flint, Calcedony, Corn-
-elian, Chrysoprase, Opal, Cat's eye, Pumice, Jasper, Ob-
-sidian, Tufa, Calcedonthus, Rock Crystal, Touchstone, Prak-
-ash, Siliceous Tufa, Hyalite, Agate, Felspar, Adularia
Cacholite. These are but the least of which are composed of
pure silex, as also amethyst. The scotch pebbles
Cairn Gorm & Agate otherwise called Heath pebbles,
are almost entirely composed of pure silex. Pure si-
-lica in this state is a light white powder, which
feels rough & dry when rubbed between the fingers &
is both insipid & inodorous. From its insolubility
it does not change vegetable colours. It appears to
possess the properties of an acid rather than an al-
-kali. Its most extraordinary property is one said may
be crystallized, which can be obtained from all glass manu-

If this cannot be procured, quartz, flint or rock crystal may be taken, exposed to a red heat & thrown into cold water in order to pulverize them.

Glass making. The most important compound of silica is glass, which is prepared by fusing it with a mixed alkali, as potash or soda. This compound varies very much in its properties, according to the purity of the materials employed & the proportion in which they are mixed. a small quantity of manganese removes the green tint of glass & oxide of lead gives it more fusible & improves its lustre. — Fuse 3 parts of flint-glass with one part of purified carbonate of potash in a crucible. A brittle glass will be obtained of a greenish tint, caused by the iron which the flint contains. This glass is a silicate of potash. — Fuse another portion of the same materials with 1 or 2 pr. of the peroxide of manganese; the glass will be found to have lost its green tinge & to acquire a trace of purple.

In another crucible fuse 3 parts of the carbonate of potash with 5 of the red oxide of lead & 10 of sand. The result will be flint glass. If manganese be added, the glass will have a rich purple colour & by adding cobalt to the mixture, a blue glass will result.

Fuse 1 part of sand with 3 of the carbonate of potash. Pour the liquid on an iron plate after all the effervescence has ceased. The compound procured in this manner has all the appearance of glass, but is deliquescent & speedily on exposure to the air is very soluble in water. Hence it is called silicated Potash.

Experiments. Add a little sulphuric or nitric acid to a solution of silicated potash & the silica will be deposited.

Add a solution of muriate of Ammonia to a solution of silicated Potash, & the whole of the silica will be deposited.

To make Glass on a large scale. Green bottle glass is a coarse glass made from very impure materials such as Seine sand, which contains iron, the most common kind of kelp or pearl-ashes.

Crown or window glass is made of a purer alkaline salt which is free of iron.

Flint glass is made of the very purest materials & contains a little peroxide of manganese to deprive it of its green hue, also litharge is employed to render it more fusible.

Plate glass is the same as Flint glass, but contains no lead.

ORDER III.

Arsenic

Metallic Arsenic sometimes occurs native, but more frequently in combination with many other metals, such as iron & cobalt. On roasting these ores in a reverberatory furnace, the arsenic being easily volatilized is evolved, combines with oxygen as it arises, & condenses into thick cakes in the roof of the chimney. This sublimed mass, after being purified by a second sublimation, forms the virulent poison, known by the names of Arsenic, White oxide of Arsenic or Arsenious acid. From the oxide of Arsenic, the metal may easily be procured by means of charcoal. Arsenic is an exceedingly brittle metal of a strong & metallic lustre & colour running into steel grey. Its structure is crystalline & its density is 8·3. When heated to 356 of Fahrenheit, it sublimes without fusion, & liquifying, for its point of fusion is above that of its sublimation. Its vapour has a strong odour of garlic, a property possessed by no other metal & hence a characteristic test of Arsenic. Arsenic burns at a high temperature with a blue flame.

Arsenious Acid

This is the most important compound of Arsenic for it is frequently administered as a poison. It is usually met with in the form of a fine white powder, or in opaque white masses. It is semi-transparent, when newly sublimed & presents an adamantine lustre. If a stream of sulphuretted hydrogen is passed through a solution of arsenious acid, the solution becomes yellow & sulphuret of arsenic is deposited. If a stream of sulphuretted hydrogen is passed through the arsenite of Potassa, no precipitate is produced as the sulphuretted hydrogen is unable to decompose it. [illegible] an excess of mu-

nitrate acid immediately the characteristic yellow colour will appear.

Put a few drops of a solution of Arsenious acid in water into an ounce or two of water and to a small quantity of the Bipersulph. Iron, Bipersnitrate or Biperacetate of Copper, no colour is produced. The liquid remains transparent. if no alkali has been present, but if a small quantity of an alkaline solution be added, the Green immediately appears, which is a perarseniate of Copper. This substance is used in commerce as a pigment. If the arsenious acid had been previously combined with Potassa, the gras-green colour immediately appears. If to a solution of the arsenite of Potassa with the bipersulphate of Copper the characteristic green tint will immediately appear.

To a solution of arsenious acid add nitrate of Silver. When a little Carbonate of Potassa & a yellow Biperacetate will be formed, which is carbonate of silver. this test however will be detected by the presence of Phosphate, Arsenic gives a similar precipitate with nitrate of Silver.

Mix two tea spoonfuls of lime-water with a small quantity of arsenious acid, arsenate of lime will be deposited in the form of a white powder. other bodies however, as Muriatic acid & Carbonic acid give white precipitates also with lime water.

Put a few drops of the bichromate of Potassa into a solution of arsenious acid & ammonia: there will be deposited arsenite of silver, as Sulphate of silver will be decomposed with the same.

No test however of Arsenic is infallible. but except the following. Take some of the liquid suspected to contain Arsenic; filter; Pass sulphuretted hydrogen through it; a yellow powder will be deposited. Collect the yellow powder; mix it with its weight of charcoal. Put a little of the compound into a small testing tube & apply heat. If Arsenic be present the smell of Garlic

will be deposited & scales of metallic arsenic will be deposited in the cold part of the tube. This is an infallible test.

Though many things have been recommended as sulphuretted hydrogen water, lime water, mucilaginous fluids, there is no effectual antidote to this poison.

Arsenic Acid

Arsenic acid is prepared by digesting metallic arsenic or arsenious acid in strong nitric acid; evaporating the solution to dryness in a glass or earthen vessel. The residue must then be heated to redness. If equal parts of nitric & arsenious acid are fused together in a crucible, the nitric acid is completely decomposed, part of the arsenious acid contains oxygen from it & being converted into arsenic acid, combines with the Potassa of the nitre forming arseniate of Potass. This is readily dissolved in water & gives with nitrate of silver a brick red precipitate, which is the arseniate of silver.

Arseniuretted Hydrogen

This gas may be prepared by digesting an alloy of tin & arsenic in common liquid muriatic acid. A portion of the water is decomposed, muriate of tin remains in solution & arseniuretted hydrogen is procured. The presence of arsenic may be detected in the following manner by the presence of this gas. Proceed as in forming hydrogen. Add the sulphuretted liquor, inflame the gas evolved & if a plate of glass be placed above the flame, metallic arsenic will be deposited upon it. This extremely deleterious & therefore it is unsafe to procure it. having a fetid colourless, elastic & has a fetid odour like that of Garlic. Its specific gravity is 1.0.578 extinguishes bodies in combustion but burns with a blue flame depositing arsenic.

Protosulphuret of Arsenic v. Realgar

This body is obtained by mixing arsenious acid with $\frac{2}{6}$ of its weight of sulphur disposing the mixture to heat in a covered crucible, till it is fused. Part of the sulphur unites

with the oxygen of the arsenious acid, forming sulphate of lead gas, which is disengaged; and a deep red mineral remains in the crucible, which is Realgar. This body is referred to next in a crucible, of Realgar, & when combined forms the Realgar of commerce.

Yellow Sulphate of Arsenic or

This may be prepared in the same manner as the former, but equal quantities of sulphur & Arsenic must be taken. It may also be formed by transmitting a stream of sulphuretted hydrogen gas through a solution of arsenious acid. This body is employed as a pigment & the colouring principle of the paint called King's yellow. It has also been proposed to use this substance to dye silk cotton & woollen stuffs of a yellow colour. The method is as follows; the cloth is soaked in a solution of orpiment in Ammonia & then suspended in a warm apartment; the orpiment & alkali evaporate & leaves the orpiment permanently attached to the fibres of the cloth. Sulphuret of arsenic is not so poisonous as arsenious acid; hence the efficacy of sulphuretted hydrogen water in cases of poisoning by arsenic. The native sulphurets of arsenic are quite inert, whereas those prepared are poisonous - Facts which have not yet been explained.

Chloride of Arsenic

This compound is formed when arsenic is burnt in a jar of chlorine gas. It is a colourless volatile liquid which fumes strongly on exposure to the air, hence called fuming liquor of Arsenic.

Arsenites or

The properties of these compounds we have previously noticed under arsenious & arsenic acid.

ORDER. I

Uranium

This metal was discovered in 1789 by Klaproth from a mineral of Saxony, which is called from its blend colour Pitch Blend which consists of Protoxide of Uranium & oxide of Iron. The mineral Uranite, of a rich green colour consists of Oxide of Uranium & Copper. From Pitch Blend, Uranium is extracted in the following manner; heat the mineral to redness, reduce it to powder & digest it with nitric acid taking care to have an excess of Uranium. Nitrate of the peroxide of Uranium is formed. This substance is of a beautiful Canion-yellow colour, when exposed to heat. It gives out its nitric acid, leaving the peroxide of Uranium. When a stream of hydrogen gas is conducted over a. the peroxide of Uranium heated in a glass tube, a substance is procured of a crystalline texture, metallic lustre & a reddish brown colour. This body when exposed to the air suffers no change, but when exposed to heat it absorbs oxygen & is again converted into an oxide. From this it is inferred that it is a metal.

Protoxide of Uranium

This substance is of a dark green colour & is obtained by decomposing the nitrate of the peroxide by means of heat. It is exceedingly infusible & bears any temperature hitherto tried without change. It unites with acids forming salts of a green colour. It is readily oxidized by nitric acid, & forms a yellow substance, which is the nitrate of the peroxide.

Peroxide of Do

This is of a yellow colour & most of its salts have a similar [illegible]. It not only unites with acid, but also with alkaline bases. It is precipitated as a carbonate by the carbonate of soda or ammonia & is re-dissolved by an excess of the precipitant.

Titanium

This metal was first recognized as a new substance by Mr. Gregor of Cornwall, but its existence is afterwards determined by Klaproth. The properties of the metal however were first accurately ascertained by Dr. Hoyle Laston in 1822. who was led to examine some minute crystals, which were found in a slag at the bottom of a smelting furnace at the great iron works of Gyllwell Merthyr in Wales. The crystals which have been found of a similar nature at other iron works are of cubic form in colour likewise resemble, burnished copper. They are also found like hairs disseminated through rock crystals these hairs are divided of Titanium. Its specific gravity is 5.3 its hardness is so great that its crystals scratch upon the surface of rock crystals. The crystals of it resist the action of nitric nitro-muriatic acid; but they are completely oxidized by being strongly heated with nitre, for a white substance results possessing all the properties of the peroxide of Titanium.

Protoxide of Do

This substance is purple & is supposed to exist pure in the mineral called Anatase; but its properties & chemical properties are entirely unknown.

Peroxide of Do

This is of a white colour & is extremely infusible, difficult of reduction; & after being once ignited ceases to be soluble in acid. A solution of Gall-nuts causes an orange red colour with it, which is very characteristic of Titanium. When a rod of zinc is suspended in the solution a purple coloured powder is gradually precipitated, which is again converted by heat into the peroxide.

Molybdenum

When the native sulphuret of Molybdenum is digested in nitro-muriatic acid until the ore is completely decomposed & the residue is briskly heated in order to expel the sulphuric acid, Molybdic acid remains in the form of a heavy white powder. From this acid, metallic Molybdenum may be obtained by exposing it with charcoal to the strongest heat of a smith's forge, or by conducting over it a stream of hydrogen gas when strongly heated in a porcelain tube. Molybdenum is a brittle metal, very infusible of a white colour. When heated in open vessels, it absorbs oxygen & is converted into Molybdic acid. The same compound is generated by the action of chlorine or nitro-muriatic acid. The protoxide is brown black; the deutoxide is brown & Molybdic acid is of a white powder, whose specific gravity is 3·4. It has a sharp metallic taste, reddens litmus paper & unites with salifiable bases. The Molybdate of lead exists as a natural compound.

Columbium

This metal was discovered in 1801 by Hatchet, in a black mineral in the British Museum supposed to have come from Massachusets in North America & from this circumstance it obtained the name of Columbium. It has also been found in Tantalite & in Wolfram. Columbium exists in it's ores as an acid in combination with iron or Manganese The acid is obtained by fusing its ore with 3 or 4 times its weight of Carbonate of Potassa when a soluble compound of that alkali results from which columbic acid is precipitated as a white hydrate by acids. It is brittle, grey & metallic lustre. It is attacked by nitro acid but is converted into Columbic acid by Potassa

Bismuth

This metal is found in the earth both native & combination with other substances, such as sulphur oxygen & arsenic. That which is employed in the arts is chiefly obtained from virgin or native bismuth. The metal is of a reddish white colour, its structure is crystalline & lamellated. When cooled slowly after being melted, large crystals of bismuth are found. When cold it is brittle, but when hot it is malleable. Fuses at 476° of Fahrenheit & subsides in close vessels at about 30° of Fahrenheit.

Oxide of Do

Oxide can easily be procured from the subnitrate. Expose this salt to a red heat. The nitric acid is evolved & the oxide remains of a yellow colour.

Nitrate of Do

The nitrate of Bismuth is obtained by pouring nitric acid on metallic bismuth. Copious fumes of nitrous acid gas are evolved & the nitrate of bismuth remains in solution. If the nitrate or subnitrate either in crystals or in solution be poured into water, a copious white precipitate is produced consisting of the subnitrate. This substance was formerly called Magistery of bismuth & is known in commerce under the name of pearl-white. From its whiteness it is sometimes used as cosmetic, but it is inconvenient from being easily tarnished by sulphuretted hydrogen.

Bismuth can be distinguished from other metals from the following characters. Nitric acid acts powerfully upon it & the solution thus procured is decomposed by water producing a white precipitate.

Chromium

This metal was discovered in 1797 by Vauquelin in a beautiful red mineral, the native Chromate of Lead. It has since been detected in the mineral called Chromate of Iron a Compound of the oxides of Chromium & Iron, which occurs in several parts of the continent of America & in Lapland, & in the highlands of Scotland. Chromium which has been hitherto obtained in very small quantities is obtained by exposing the oxide of Chromium mixed with charcoal to the most intense heat of a smith's forge. The metal is said to be brittle of a reddish white colour & is very infusible.

Protoxide of Do

This oxide is easily prepared by dissolving the bi-chromate of Potassa in water & precipitating it with a solution of the protonitrate of mercury; when an orange-coloured precipitate the protochromate of mercury, is procured. On heating this salt to redness in an earthen crucible, the mercury is dissipated & the protoxide of Chromium remains. The protoxide is of a green colour, exceedingly infusible & suffers no change from heat. Deflagrated with nitre, it is oxidized into maximum & thus converted into chromic acid. When fused with Borax, it imparts to it one of the finest green colours we possess, & hence the extensive use of the oxide of Chromium in the arts. To this oxide the emerald is indebted for its green colour.

Deutoxide of Do

The brown or deutoxide of Chromium is obtained by exposing the nitr protonitrate of Potassa to a temperature precisely sufficient for decomposing the nitric acid. It has not hitherto been studied with care.

Chromic Acid

This is procured by digesting the chromate of Baryta in dilute Sulphuric acid exactly sufficient for combining with the baryta. The sulphate of baryta subsides & a solution of chromic acid is obtained. It crystallizes in [illegible]

Salts of Chrome

Chromate of Potassa

This salt is obtained from a mixture of nitre & common Chrome iron ore usually termed Chromate of iron; but which is composed of the oxides of chrome & iron mixed with earthy matter. The ore must be reduced to very fine powder & mixed with an equal weight of nitre. The mixture then must be exposed to a red heat. Chromate of Potassa is formed; the residuum matter must then be mixed with water & filtered to separate the iron. When the solution is evaporated, it deposites lemon-yellow coloured crystals, which are soluble in twice their weight of water.

Bichromate of Potassa

This salt is prepared by adding sulphuric acid to a solution of the neutral chromate of Potass. Sulphate of potassa is formed & in solution & the bichromate falls to the bottom, which is of a red colour. Add a solution of the carbonate of potassa to a solution of the bichromate of Potassa. As soon as the acid is neutralized the solution will again assume a lemon-yellow colour. If a drop of sulphuric acid be put into the yellow solution the red colour is again restored, or in other words the bichromate of Potass is again produced.

Chromate of Baryta

When a solution of the chromate of Potassa is added to a solution of the muriate of Baryta, the chromate of baryta is formed, which is of a yellow colour. This used in the arts as a pigment.

Chromate of Lead

This is prepared by adding a solution of the chromate or bichromate of Potash to a solution of the acetate of lead as long as any precipitate is produced. This well known in commerce under the name of chrome-yellow. & is one of the finest yellows that can be produced.

Bichromate of Lead

The dichromate of lead also called the subchromate of lead is formed in the following manner. It may be prepared by mixing intimately equal weights of chromate of lead & one of carbonate of lead. It has a beautiful red colour. When nitric acid is poured upon it, it is converted into nitrate of lead & chromic acid is deposited.

Chromate of Mercury

This is an orange-red colour & is prepared by adding a solution of nitrate of protonitrate of mercury to a solution of the bi-chromate of Potass. as long as any precipitation takes place. Chromate of mercury remains in solution

Chromate of Silver

Chromate of silver is prepared by adding nitrate of silver to a solution of the bichromate of Potass. It is dark red or purple colour.

Nickel

This body is a constituent of meteoric iron-stone; but it is generally procured from the sulphuret of nickel found in Westphalia. To obtain this metal in a state of purity, reduce to powder a quantity of the alloy of arsenic & nickel, well known in commerce under the name of ~~Grise~~ Spiss. Boil it in dilute sulphuric acid, & the solution made to cool & nitrate of nickel will be deposited. Dissolve in water & add carbonate of soda. Carbonate of nickel will be the result. Through the solution of the carbonate pass chlorine & muriate of nickel is obtained. Then add oxalate of ammonia & oxalate of nickel is the result & by heating this to redness, metallic nickel is procured. Metallic nickel is obtained in the form of an ash-coloured powder & by exposing this to a very high temperature it fuses or melts. Metallic nickel is of a whitish colour, intermediate between that of tin & silver. It has a strong metallic lustre & is both ductile & malleable. It is attracted by the magnet & like iron & cobalt may be rendered magnetic. Its specific gravity is 8·279. & by hammering it, it becomes 9·00.

Protoxide of Nikel

This compound is of an ash grey colour & is obtained by heating the carbonate, oxylate, or nitrate to redness in open vessels. It is not attracted by the magnet & is a strong alkaline base. By the fixed alkalies it is precipitated of a green colour, but is redissolved by Ammonia in excess.

Peroxide of Do

This is prepared by transmitting chlorine through water in which the protoxide is diffused in fine powder. Water is decomposed, the hydrogen forming muriatic acid with part of the chlorine & the oxygen unites with part of the oxide of nickel converting it into the Peroxide, which remains undissolved. Nitric & muriatic acids are the best solvents of nickel. Its salts are of a green colour & give an apple green precipitate with Potasa.

Copper

This metal is distinguished from all others except Titanium by its red colour. It receives a considerable lustre by polishing. Its density 8.78 is increased by hammering. It is both ductile & malleable but its tenacity is inferior only to that of Gold & Silver & consequently dangerous. In flexibility it stands between Silver & Gold. Copper in a dry atmosphere does not rust; but when exposed to air & moisture a green film is formed on the surface which is a carbonate of the peroxide. Copper is frequently found in the earth native: but the most of the Copper of commerce is obtained from the Copper Ores. When copper is heated to redness a red scale is formed on the surface & the copper itself tinges the flame green. In Cornwall much Copper is obtained in the following manner. Masses of iron are put into water impregnated with Copper. The iron is corroded & Copper is obtained. (This experiment will be exemplified under Sulphate of Copper). When Copper is polished of a bright colour, it need only be washed in dilute nitric or muriatic acid. nitric acid.

Protoxide of Do

If a piece of copper be exposed to a red heat for 10 minutes, scales of a red colour are formed upon its surface. Quenching it suddenly in cold water, the metal that remains detaches the scales are thrown off, which are of a bright red colour. This is the protoxide of Copper.

Peroxide or Black Oxide of Do

This compound which is of a black colour is formed by exposing the nitrate of Copper to a red heat. The nitric acid is evolved & the peroxide of Copper is left.

Tests of Copper. Copper is generally recognized by its giving a purple blue precipitate with Ammonia. With Prussiate of Potass it gives a dark brown. When a piece of iron is suspended in a dark red solution of any salt of copper, metallic Copper is deposited. This is one of the chief characteristics of Copper.

Chloride of Copper

When copper filings are introduced into an atmosphere of Chlorine it takes fire spontaneously & the chloride of Copper is generated. This formerly was called Resin of Copper.

Sulphuret of Copper

This is the copper-glance of the mineralogists & can be formed artificially by heating copper filings with 1/3 their weight of sulphur. The combination is attended with such free disengagement of calorie, that the mass becomes vividly luminous. This may be exemplified in a spoon flounce flask. It is of a yellow colour.

Bisulphuret of Do

This is a constituent of Copper Pyrites. It may be formed artificially by the action of sulphuretted Hydrogen on a per-salt of Copper. When exposed to a red heat in a close vessel, it loses half its sulphur & is converted into the protosulphuret. This is of a darker yellow than the former & has the smell of sulphur.

Nitrate of Do

This is obtained by pouring dilute nitric acid on Copper. It is of a blue colour & is used in medicine as an escharotic.

Experiment. Spread a drachm or two of the nitrate in powder on a piece of tin-foil several inches square. Moisten it with 2 or 3 drops of water & fold it up quickly, taking care to throw it down whenever it begins to grow hot. Small sparks are seen from the tin burning with a red flame.

Sulphate of Do

This salt is seldom prepared in a Laboratory, as it is manufactured in large quantities for commercial purposes, by evaporation from mineral waters in Copper mines, or formed by the oxygenation of the native sulphuret. It has long been known by the name of blue vitriol & is used in medical practice as an escharotic & astringent. It is of a deep blue colour & is known in the laboratory by the name of "Blue stone."

Carbonate of Copper

The beautiful green mineral called Malachite is a Carbonate of Copper & this compound may also be formed artificially by exposing metallic copper to air & moisture, it is the blue coloured powder formed on copper, when exposed to the atmosphere. Blue Verditer used as a pigment is formed by decomposing the nitrate of copper by chalk.

N.B. It is extremely dangerous to allow vegetable substance to cool in copper vessels, because verdigris is the result, which is an ardent poison. Cheese is frequently contaminated by placing it in copper nails to make it appear decayed. Albumen or the white of eggs has been proved by Orfila to be a complete antidote against poisonous effects of copper. Sugar is also supposed to do the same.

Tungsten

Tungsten may be procured in the metallic state by exposing tungstic acid to an intense heat mixed with charcoal. It has a greyish white colour & considerable brilliancy. It is one of the most infusible of the metals & is nearly equal to steel in hardness. When heated in the open air or digested in nitric acid oxidation ensues & it is converted into tungstic acid.

Tungstic acid

The best method of preparing this is by digesting the native tungstate of soda in muriatic acid, by which means the metal of soda is removed & tungstic acid remains in the form of a yellow powder. It is also prepared by the action of muriatic acid upon Wolfram the native tungstate of iron & manganese. This acid is of a yellow colour, is insoluble in water & has no effect on litmus paper. Both the tungstates which are decomposed by the stronger acids & which consist of tungstic acid & an alkali or earth exposed to the action of hydrogen gas at a high temperature of 5° to 600°

Cobalt

This metal is met with in the earth chiefly in combination with arsenic, constituting an ore from which all the Cobalt of commerce is derived. It is an ingredient of mckenic ores & the name "Cobalt" signifies "Evil Spirit" given to it by the superstition of the miners of Germany.
When the native arseniate is broken into small pieces & exposed to the action of heat & air in the Reverberatory furnace its elements are oxidized. Most of the arsenious acid is expelled in the form of Copper coloured vapour, & the oxide of Cobalt called ~~Zaffre~~ Zaffre is obtained. In heating this substance with a mixture of Sand & Potash, a beautiful blue coloured glass is procured known in commerce under the name of Smalt. Metallic Cobalt is not much employed in the Arts. Solutions of salts of Cobalt give a blue colour precipitate with solutions of the Alkalies. In much greater blue than that with Copper) & before the blow pipe when mixed with borax, it produces a beautiful coloured blue glass. Nitrous acid of Sodasse gives a light green precipitate & hydro sulphuret gives a black.

Protoxide of Do

The Protoxide of Cobalt is often met with in the state of ~~Oxide~~ of Cobalt, most of which are of a fine blue colour. When Cobalt is heated in open vessels, it absorbs oxygen & is converted into the protoxide. It is prepared by decomposing the Carbonate of Cobalt.

Peroxide of Do

Is remarkable for forming the compound that already been mentioned. It is of a black colour.

Nitrate of Do

is formed by digesting Cobalt in nitric acid. It is of a pink colour

Sulphate of Do

This salt is obtained by dissolving the oxide in sulphuric acid.

Carbonate of Do

This is precipitated when nitrate of Cobalt & carbonate of Soda are mixed together in solution.

Muriate of Cobalt

A solution of this metal is rendered sympathetic ink. Characters traced with it on paper become no mark when dry if the solution be not strong (in which case it burns) & appear of a fine colour when exposed to a gentle heat, which again fades when it cools or when breathed into water. The solution is prepared by dissolving the carbonate in muriatic acid with heat & by adding to the solution a quantity of common salt equal to the weight of the cobalt employed. The solution should be rather dark & will appear green whilst hot.

Tellurium

This is a rare metal hitherto found only in the gold mines of Transylvania where it is very much prized. Its colour is between white & grey inclining to red. Specific gravity 6.115 by Klaproth. Becomes on the application of heat exceedingly volatile & burns with a blue flame. Its oxide is of a yellow colour & is reduced by charcoal. Its compounds with acids & alkalies are but little known. Its oxide is soluble in water & has a sweetish taste. Exposed to a moderate heat it becomes fluid like oil & on cooling crystallizes in needles. When heated before the blow pipe with charcoal it is volatilized with a blue flame & a peculiar smell.

Oxide of Tellurium

This oxide is prepared by nitric acid & the soluble matter of the oxide separated. This oxide is likewise obtained by exposing the metal to a high temperature. When heated before the blow pipe with charcoal it is volatilized with a blue flame. It has the property of forming salts with acids & alkalies. It unites with hydrogen forming Tellureted hydrogen gas. Sulphur has the same property & the hydrogen gas formed is called Tellureted sulphuretted hydrogen gas.

Antimony

This metal derives its name from the fact that on its discovery it proved fatal to some monks. Basil Valentine found that a preparation of antimony enriched the skin of dogs & thereupon administered it to some monks in order to render them more sleek, however the unfortunately it proved fatal. Hence the name (Antimoine). This metal sometimes occurs native, but more frequently in the form of the sulphuret, which is the "crude antimony" of commerce. To obtain antimony from the sulphuret in the laboratory mix 4 oz. of nitre, with 6 oz of the cream of Tartar & 12 oz of sulphuret of Antimony all being previously reduced to powder. Throw the mixture in small quantities at a time into a red hot crucible. Rapid deflagration ensues & a button of metallic antimony is found at the bottom. Antimony is a brittle metal of a white colour running into bluish grey & is possessed of considerable lustre. Its density is about 6.7. At 810° of Fahrenheit it fuses & when exposed to a slight red heat in a crucible, it burns with a bluish flame.

Protoxide of Antimony

When the muriate of the protoxide of antimony made by boiling the sulphuret of muriatic acid is poured into water, a white curdy precipitate formerly called Powder of Algaroth was obtained, which is a submuriate of the Protoxide. On digesting this salt in a dilute solution of Potassa & then edulcorating it with water the Protoxide is obtained in a state of purity. It may also be procured by digesting the carbonate of soda or Potassa with Tartar-emetic. The protoxide is a dark brown white colour & the base of Tartar emetic. The presence of Antimony in solution is easily detected by sulphuretted hydrogen. The Protosulphuret of Antimony is formed of an orange red colour. If this add muriatic acid, sulphuretted hydrogen gas is formed & muriate of Antimony is formed which gives its characteristic last white colour when poured into water.

Deutoxide of Antimony

When antimony burns or is strongly heated in open vessels the deutoxide is generated, sublimes, & condenses on cooled surfaces in the form of acicular crystals of silvery whiteness, formerly called Argentine flowers of Antimony. This oxide does not fuse readily, but is more volatile than the protoxide. It is sometimes called Sebacious acid (a. Sebacium).

Peroxide of Do

This is prepared by adding hot nitric acid to metallic antimony & evaporating to dryness at a high temperature. This is the Diaphoretic antimony of the Pharmacopeias. Its colour is yellow.

Chloride of Do

This substance is formed when antimony is burned in chlorine gas. It is generally called "Butter of Antimony" & is of a white colour.

Sulphuret of Do

This substance occurs native & called grey ore of Antimony & may be formed artificially by passing sulphuretted hydrogen through a solution of Antimony. Kermes mineral is formed when Sulphuret of Antimony is boiled in a solution of Potassa.

Sulphate of Do

Sulphate of Antimony is procured by digesting metallic antimony in sulphuric acid.

Muriate of Do

This is prepared by mixing sulphuret of Antimony with muriatic acid & sulphuretted hydrogen gas is evolved.

This substance is the most interesting of all the compounds of Antimony & is used to a great extent both in medical & surgical practice. It is prepared by boiling together equal weights of cream of Tartar & oxide of Antimony in 4 times their weight of water, filtering the solution & thereby the substance to be deposited. Its most delicate test is sulphuret of hydrogen which produces a reddish brown precipitate. When too large a dose of this salt has been given the tartaric acid & sulphuretted hydrogen, solutions of the hydro-sulphurets & infusions of Cinchona bark, galls or tea.

Cerium

This metal was discovered in 1803 by M. M. Hesringer & Berzelius in a rare swedish mineral called cerite. The properties of Cerium are very little known, as no piece of the metal larger than a pin's head has yet been obtained. It is a white brittle metal. It is soluble in nitro-muriatic acid. At a very high heat it is volatilized.

Protoxide of Cerium

This is a white powder which is insoluble in water. When heated in open vessels it is converted into Peroxide. Oxylate of Ammonia & alkaline carbonates give a white precipitate.

Peroxide of Cerium

This substance is of a fawn-red colour. It is a weaker base than the protoxide.

Lead

This metal through deficient in hardness & elasticity & ductility is known of great use in the metallic state from its malleability. It alloyed with Arsenic for common shot & an alloy of lead, Tin & Bismuth it is so very fusible that it fuses in tea with an ordinary temperature. Lead is also used in the manufacture of glass & in glazing porcelain and the acetate of lead is used in medical & surgical purposes as an astringent. This metal is generally obtained from Galena, the native sulphuret of lead & in the laboratory can be easily reduced by the action of the blow-pipe when placed upon charcoal. When it is required particularly pure dissolve acetate of lead in water & suspend in it a piece of zinc; metallic lead is deposited & the acetate of zinc remains in solution. When pure it assumes in arborescent, hence this particular appearance is called "Arbor saturni." Its specific gravity is 11.388 & at 612° it fuses. Nitric acid acts

powerfully upon lead. most of its compounds are poisonous. When fused in open vessels at a high temperature a grey film is formed on its surface, which is a compound of lead & oxygen.

Protoxide of Lead

This is the substance formed on melted lead, when exposed to a high temperature. This substance is absorbed by bone-ashes hence the process of cupellation, adopted to separate silver from lead. The metal supposed to contain silver is placed upon bone-ashes & exposed to heat. The protoxide of lead is formed, which is absorbed by the bone-ashes & the silver remains pure. The same process is adopted to separate copper from silver. The hollow brick employed to cover cupels is called a muffle. The protoxide of lead in commerce is called Mass[illegible] cot & when partly vitrified it is called litharge. Massicote is yellow. litharge a yellowish red.

Deutoxide of Do

This is Minium of commerce. This compound is procured by directing a stream of air on heated massicot until it assumes a red colour. It is employed in the manufacture of glass &c. & another way of preparing these compounds is by exposing the carbonate of lead to a high heat. & massicot remains & this last being exposed to air & a high temperature minium is again procured. Iodide of Potassium forms with the salt of lead with which it produces a yellow coloured precipitate which is the Iodide of lead.

Nitrate of Do

This salt is prepared by digesting litharge or metallic lead in dilute nitric acid. It is a virulent poison & is white.

Sulphate of Do

This mineral is found native it is of a white colour & is formed artificially whenever sulphuric acid or a soluble sulphate is added to a solution of a salt of lead. The sulphate of lead is insoluble & inert & hence as it is proved by M. Orfila, any soluble sulphate such as Epsom salts &c is a complete antidote against poisoning by lead. As

Phosphate of Lead

This is the green lead spar. & brown lead spar of the mineralogist & is a compound of Phosphoric acid & lead.

Chloride of Do

This is procured by adding muriatic acid or a solution of a muriate to a salt of lead. It is the horn. lead or Plumbum Cornuum of commerce.

Iodide or Iodurate of Do

This is formed by adding Iodide of Potassium or Hidriodate of Potassa to a solution of lead. It is of a rich yellow colour & is called as a pigment "King's yellow."

Sulphuret of Do

This maybe made artificially either by heating together lead & sulphur or by the action of sulphuretted hydrogen on any soluble salt of lead. It is the Galena known in commerce under the name of "Galena."

Acetate of Do

This is the sugar of lead of commerce. It may be obtained easily on the small scale by boiling carbonate of lead with vinegar. In the large scale it is obtained by placing sheet lead in contact with the refuse of grapes. By fermentation acetic acid is generated, which corrodes the lead & by evaporating filtration & evaporating sugar of lead is procured which is extensively used in medical & surgical practice as an sedative & astringent.

Carbonate of Do

This is the "Ceruse" of the painter & white lead of the dyer. It is used extensively as a paint. It can easily be prepared by adding the carbonate of Potassa to any soluble salt of lead; but in the large scale sheets of lead are exposed to the fumes of vinegar, when by the united action of the atmosphere & the acid fumes the lead is both oxidized & converted into a carbonate. This is tasteless & is almost insoluble in water, but not so much so as the sulphate but is readily decomposed by the alkalies.

Manganese

This metal was discovered in 1774 by Gahn & Scele. it is a hard brittle metal of a greyish white colour & glaneda lustre. Its specific gradity is 6·85. It is excedingly infusible; soon tarnishes on exposure to the air & is rapidly oxidized when heated to redness. This metal has such an attraction for oxygen, that the most intense heat of a smith's forge will not reduce it. To procure the metal reduce the black oxide to powder make it into a paste with oil & charcoal & you will obtain a small button when it is exposed to a white heat for about an hour.

Per-Oxide of Manganese

This is the well known compound called the Black oxide. It is obtained in the earth in great abundance. By structure is sometimes massive & frequently radicated. When exposed to heat it parts with part of its oxygen & hence is used in the preparation of oxygen gas. It is used in the manufacture of glass for preparing chlorine for bleaching. It unites neither with acids nor alkalies & it always loses part of its oxygen. It must therefore be converted into a sub-oxide before the salt is generated.

Deutoxide of Manganese

This is the Peroxide in the formation of oxygen gas. When reduced to powder it is of a brown colour, but when exposed to the air it rapidly absorbs oxygen & is converted into the Peroxide. With sulphuric & muriatic acid. Proto-salts are formed & the peroxide remains.

Protoxide of Manganese

This is formed when a stream of Hydrogen gas is passed over the peroxide at a red heat. It is also obtained by mixing the peroxide with charcoal & exposing it to a white heat in a porcelain tube. It is of a green colour. As the manganese of commerce is contaminated with iron it is manifest in adding to a solution of any of the salts the Prussiate of Potass.

Muriate of Manganese

To obtain the muriate (the most important salt of manganese) in a state of purity, Dr. Faraday recommends the mixing of the Peroxide of manganese with an equal weight of the muriate of ammonia & exposing the mixture to heat in a crucible for a quarter of an hour. The chloride of manganese treated by distilled water & filtering, any iron & other extraneous substance, with which the manganese may have been combined is separated. The muriate thus procured is absolutely pure.

Manganeseous Acid

The manganesite of Potash is obtained in the following manner. Mix one part of the peroxide of manganese with 4 or 5 of pure Potash expose the mixture for half an hour to heat in a crucible.

The manganesite of mineral chameleon results.

Experiments. 1 Introduce into a wine glass a small piece of the mineral chameleon, pour over it a little water. A green solution will result. Add more & it will become blue & by further addition it will successively become purple & deep purple.

2. Put equal quantities of these substances into 2 separate glasses & pour hot over one & cold over the other. The hot solution will give a green & the cold a purple coloured

Tests of Manganese. Muriate of Potash gives a white solution.

Hydro-sulphurets give a yellow precipitate, sulphuret of manganese. Alkalies throw down a white precipitate which gradually becomes black when by being converted into the oxide. Salt of manganese or Borax being exposed to the flame of the spirit lamp a purple flame is procured.

Iron

Iron is the most useful of all the metals & necessary to the civilization of man. It is an abundant production of nature. It is found in Rocks of every age. It exists in the blood of animals, in trees, & occasionally falls from the heavens, though the reduction of meteoric iron & has not been proved in mineral philosophy, but it is however beyond doubt. Iron is of a grey colour & possesses strong metallic lustre. In malleability & ductility it is inferior to several metals, but in tenacity it surpasses them all. It possesses the useful characteristic property of being capable of being welded when heated to high temperature. Its texture is fibrous its specific gravity 7.78 It is attracted by the magnet & may be rendered itself permanently magnetical It may be rendered permanently magnetical by several processes. An iron rail or bar placed perpendicularly in the Earth becomes magnetic. A porter which is allowed to stand for several days in an upright position becomes also magnetic. Iron is generally in the form of an oxide & the iron of commerce is procured from this mineral by reducing it with Lime & Charcoal. Pig or cast iron is a Carburet of Iron & is obtained by reducing the native oxide. Cast Iron is brittle; but is admirably adapted for castings as it possesses the property of expanding when cooling. Malleable iron is obtained from this by exposing the carburet in a reverberatory furnace. This process is called puddling. Iron is combustible as was exemplified under Oxygen gas. By its combustion Protoxide of Iron is formed.

Protoxide of Iron

The scales that fall from the anvil on hammering hot iron are a compound of the Protoxide & Peroxide of Iron. This substance is of a dark blue colour & when melted with vitreous substances communicates to them a blue tint — It is attracted by the magnet, though less powerfully than metallic iron. The salts of the Protoxide of Iron are precipitated of a white colour by the Prus-

cyanade of Iron. Boerhaave called any of the Peroxide des Iron the characteristic blue tint it again produced. Pure alkalies give also a white precipitate which becomes brown on exposure to the air. but gases give no precipitate with

Peroxide of Iron

this substance is easily procured by exposing the sulphate of iron or green vitriol to heat in a crucible. The sulphuric acid passes off & Peroxide of Iron remains which is of a red colour With this the ferrocyanade of Potash gives a blue precipitate (Prussian blue.) & Ac. and gives a black powder with. When the black oxide of Iron occurs native, it is called Hematite.

Chloride of Do

This is obtained by exposing the muriate of iron to heat. Its dry colour & crystalline texture.

Carburet of Do

Charcoal & Iron unite in various proportions forming at least 4 compounds which are perfectly distinct, namely "Cast or Pig iron." "Steel" Cast steel, & Graphite or Plumbago or the black lead of the Carpenter). To the formation of Cast Iron we have already alluded. It is neither ductile nor malleable & fuses with such facility at a red heat that it cannot be welded. It is highly crystalline. Its texture is granular & it contains 1/43 of its weight of charcoal or Carbon. How metallic iron is procured from this has been also mentioned. Steel is made by exposing bars of the purest malleable iron surrounding it with Charcoal in powder for a long continued Red heat. During this process the iron unites with about 1/150 of its weight of charcoal. & acquires new properties. In ductility & malleability it is greatly inferior to iron but far excels it in hardness, tenacity & elasticity. Its texture is more compact than that of iron & it is susceptible of a far higher polish. It bears a strong Red heat & may be welded with iron.

Cast Steel. Common steel can be made to unite with an addi-
-ditional quantity of Charcoal & then it constitutes "Cast
Steel". In this state it is harder, more elastic, has a close
texture & receives a higher polish than common steel. It
is however rendered again so fusible that it cannot be wel-
-ded. This compound contains about 1/100 of its weight
in Charcoal. It unites the fusibility of Cast with the mal-
-leability of bar iron & when heated & suddenly cooled
it becomes very hard, whence its superiority for the
manufacture of cutting instruments. Steel is easily
distinguished from iron by the following process, which is
recommended for the test of Knives. When a drop of pure
dilute acid is dropped upon steel a black stain remains
from the Carbon of the steel, with the iron no mark
is left.

Graphite. This is a native Carburet of Iron sometimes
termed "black lead". It contains 95 per cent. of Carbon
& hence like the diamond almost entirely composed of
Charcoal. It is unchangeable in the air, has an iron grey colour
metallic lustre & granular texture. Its chief use is in making
pencils & crucibles for burnishing cast iron to protect it
from rust.

Phosphuret of Iron

This is obtained by exposing the Phosphate to heat with
Charcoal. It sometimes contained in metallic iron to
the properties of which it is extremely injurious by causing
it to become brittle at common temperatures.

Sulphuret of Iron

Protosulphuret is the magnetic iron pyrites of the
mineralogist. It is a brittle yellow substance, having
a metallic lustre & is very feebly attracted by the magnet.
This may be made artificially by igniting the Protosul-
-phate of Iron with Charcoal. by mixing 2 of Iron filings
& 1 of sulphur in a florence flask & exposing the mixture
to heat. When the last method is adopted a brilliant
gleam of light is seen, even though the flask be filled

Green ink is formed by dissolving sap-Green with a little Roch-alum in water.
Yellow ink Gamboge or saffron yellow berries or grain dissolving gum - diluted with muriatic acid Rain water must be employed.
Red Ink is made by boiling for a quarter of an hour 2 oz. of Brazil wood with a pint of Rain-water adding a little alum, gume-arabic & sugar candy.

To make Black ink. Boil 2oz. of log-wood in small chips with 4 oz. of nut-galls reduced to powder in 6 lb of water till half the liquid is evaporated. Strain the decoction through a green cloth & add 2 oz. of the sulphate of iron 1/2 oz. of the sulphate of copper 1/2 oz. of gum arabic & 1/2 oz of sugar the mixture must be stirred till it assume a uniform appearance & after being allowed to stand six for 12 hours it may be bottled. The use of the gum is to keep the gallate of iron suspended in the water. In copper must be one of the end of it to be written with steel pens.
N. B. Ink Stains are destroyed by chlorine water, very dilute muriatic acid, oxalic acid, or bisoxalate of Potash.
Blue ink is formed by diluting indigo & Cochineal with gum arabic.

with nitrogen gas. Also by applying a bar of iron hea-
ted to redness to a roll of sulphur. This compound is formed
by the formation of sulphuretted hydrogen.

Bisulphuret of Iron

This is the common Pyrites of the mineralogist consisting
of atoms of sulphur to one of iron. This insoluble in mu-
riatic & sulphuric acids, but by being heated is converted
into the Protosulphuret.

Nitrate of Iron

This is obtained by digesting iron filings & nitric acid. It
will only crystallize under the exhausted receiver of an
air pump. This of a green Lawn colour, but becomes brown
on exposure to the air.

Sulphate of Do

This is the green vitriol of the Laboratory it is obtained on the
large scale by exposing iron-pyrites to air & moisture. In for-
-ming hydrogen gas from ☞ iron filings, it is the residual
matter. When the sulphate of Iron is exposed to the atmo-
-sphere it becomes of a brown colour by absorbing Oxyge-
-n from the atmosphere & its solution is always turbid
from the fine oxyge that the water contains. When-
-ever becomes transparent by adding a few drops of
sulphuric acid

Carbonate of Do

This is procured by mixing solution of iron with carbo-
-nate of Potash. His of a brown colour. This is the compound
of iron found in Calybeate Springs.

Acetate of Do

This is procured by digesting iron in a dilute solution
of acetic acid.

Gallate of Do

This is of a black colour & the basis of writing ink. It is easily
procured by adding nut-galls in powder to a tincture
also to a solution of sulphate of iron.

Cadmium

This metal was discovered in 1817 by Stromeyer in an oxide of zinc. Dissolve the ore in muriatic acid. Remove all the sulphuretted hydrogen. Sulphuret of cadmium is precipitated. This is decomposed by nitric acid & nitrate of ammonia be added the carbonate of cadmium which is of a white colour is procured. When the carbonate is heated the oxide is procured & this is decomposed by means of charcoal. This metal resembles tin. It is very ductile & malleable. Its specific gravity is 8.604. It is as fusible as tin & as volatile as mercury. It condenses into globules which have a metallic lustre. Its vapour has no odour. The sulphuret is of a yellow colour like that of arsenic, but is distinguished from it by being insoluble in potash &c. It sublimes at a red heat.

Zinc

The zinc of commerce commonly called "Spelter" is obtained either from Calamine the native Carbonate of Zinc or from the native sulphuret, the Zinc blend of the mineralogist & the black-jack of the miner. It is procured from both of these by heat & carbonaceous matter in the same manner as lead. Zinc has a shining metallic lustre & a bluish white colour. Its texture is lamellated & its density about 7.0. It is a hard metal being acted on by the file with difficulty. At high or low temperatures it is brittle; but between 210° & 300° of Fahrenheit it is both malleable & ductile. At 680° it fuses. Heat it in close vessels in a covered Crucible. It bursts into flame as soon as the cover is removed & burns with a brilliant white light. The combustion ensues with such violence, that the oxide

wort is formed is mechanically carried up into the air bulb of the condensatory in the form of the Sulphuret of the Chemist & this Protoxide of the Chemist.

Protoxide of Zinc

This compound is white when in solution is easily detected by the following tests;

Forms a white precipitate with sulphuric, hydrogen, hydro-sulphuret of ammonia, hydriodate & ferrocyanate of Potassa.

Chloride or Butter of Zinc

This is formed by evaporating the muriate to dryness then heating it to redness. This salt is extremely deliquescent.

Sulphuret of Do

This is the Zinc Blende or black jack. It is an abundant production in the mineral kingdom it is formed artificially by heating to redness a mixture of the oxide of zinc and sulphur, by decomposing the sulphate of zinc with charcoal, or by exposing the white precipitate formed by adding the hydro-sulphuret of ammonia to a salt of zinc.

Nitrate of Do

This formed by pouring nitric acid upon zinc & evaporating to dryness.

Sulphate of Do

This is the white vitriol of the laboratory. It is obtained in the preparation of Hydrogen gas from dilute sulphuric acid & zinc. On the large scale it is prepared from the native sulphuret. The ore is roasted, exposed with access of air by which means it undergoes the process of sulphatization. The solution thus evaporated to crystalization & crystallized & then poured into moulds. The crystals of this salt are colourless & readily distinguished from sulphate of Magnesia excepting by the chemical tests.

Carbonate of Do

This compound is formed when carbonate of Potassa is added to sulphate of Zinc in solution. It is a white substance & the "lapis calaminaris" of the mineralogist & the Calamine of commerce. According to the alchemist it derives its name because it attaches itself to the iron bars

of the furnace when being reduced in the furnace.

Acetate of Zinc

In the formation of the Arbor Saturni, acetate of Zinc remains in solution. It is used to a very considerable extent in water as a collyrium.

Muriate of Do.

Muriate of Zinc is obtained when the metal is dissolved in sulphuric muriatic acid, hydrogen gas being disengaged.

Tests of Zinc All the salts of Zinc are colourless, soluble, not precipitated by any metal nor by infusion with nut-galls; but a white precipitate is formed with the alkalies, sulphuretted hydrogen & prussiate of Potass.

Tin

The Tin of Commerce is obtained from the native oxide which occurs abundantly in Cornwall. It is known by the name of Block & Grain-tin & is reduced by heat & charcoal. Its colour is white, & its lustre resembles that of silver. Its malleability is very considerable, for the tin foil of commerce is rolled into sheets of an inch in thickness. The characteristic of Tin is that it admits a crackling sound when bent

Protoxide of Do

The protoxide is of a grey colour & is formed when tin is fused for some time in an open vessel. When added to a solution of gold it produces a purple precipitate called the purple of Cassius. This is its test.

Peroxide of Do

When diluted nitric acid is poured upon tin a violent effervescence ensues & the nitrate of tin results. When tin is heated & fumes nitric acid is evolved & peroxide of tin remains which is of a straw-yellow colour.

To Moirée Metallique. Take a common tin plate which is in reality a plate of iron coated with tin. Heat it over a chaffer before the fire with a pair of pincers till a drop of water allowed to fall upon its surface begins to boil immediately & then wash one of its sides with a mixture of 4 parts of water 1 of nitric acid & 1 of muriatic. Its surface will immediately assume a crystalline appearance & by heating the plate a little different

places with a blow pipe a variety of tegnes may be produced
different coloured varnishes may be added.

Chlorides of Zinc

Protochloride of Do

This is obtained by evaporating the muriate to dryness & fusing the residue in a close vessel; or by heating a mixt of tin with calomel, which is the protochloride of mercury. It is a grey solid substance & fuses at a heat bellow redness.

Bichloride of Do

This is obtained by distilling 1 part of tin with three of corrosive sublimate (the bichloride of mercury). This is a colourless volatile liquid which emits copious white fumes & is known called the "fuming liquor of Libavius."

Sulphuret of Do

When tin & sulphur are joined together a yellow compound results called "aurum mosaicum".

Tests of Tin.

1/ A solution of gold gives a brown, blue, green or purple precipitate according to the quantities with which they are mixed & the degree of concentration.

2/ Plates of lead & zinc precipitate metallic tin.

3/ A solution of the bichloride of mercury gives a dark-coloured precipitate.

4/ Alkaline hydrosulphurets give a brown coloured precipitate.

5/ Ferrocyanate of Potass gives a white precipitate.

6/ Infusion of galls gives no precipitate.

Mercury

This metal besides having the name of mercury is also called quicksilver. Argentum vivum & Hydrargyrum. It is found not native but is found more commonly in compound with sulphur, when it is called Cinnabar. From this ore the mercury may be extracted by heating it with lime or iron filings. by which means the mercury is volatilized & the sulphur remains. Mercury is distinguished from all other metals by being fluid at common temperatures. It has a fine white colour & a strong metallic lustre. It becomes solid at -39° & on congealing it evinces a strong tendency to crystallize in octahedrons.

Protoxide of Do

The Protoxide of mercury is of a black colour. It is easily procured by mixing calomel with Potassa or lime-water. This is also a great desideratum for medicine.

Peroxide of Do

This is called Red precipitate. It is obtained by dissolving mercury in nitric acid & then decomposing the product to a high heat. It is of a beautiful red colour and occurs in scales. The vessel in which it is prepared is called Boyle's-bell, which it has a long neck. Many tests of mercury have been proposed, but the most simple is to drop a little of the dissolved liquid on gold & touch it with tin-foil, metallic quicksilver is formed immediately.

Protonitrate of Mercury

This is obtained by digesting metallic mercury in dilute nitric acid & then the mixture to evaporate & from already added a small quantity of fine metallic mercury, if the quantity employed should be completely dissolved.

Pernitrate of Do

This is obtained by pouring strong nitric acid on mercury & applying a head. When in solution it is employed to load the wires of a galvanic battery in order to produce intimate contact.

Sulphate of Mercury

When mercury is dissolved in sulphuric acid by means of heat. Sulphurous acid gas is evolved & Sulphate of mercury is obtained, which is of a white colour. When the sulphate of mercury is put into hot water, it becomes yellow forming what is called turpeth mineral which is a subsulphate.

Protosulphuret of Do

It obtained by rubbing together equal weights of mercury & sulphur together in a mortar till the globules disappear. It is black. It is called

Bisulphuret of Do

This is called the artificial Cinabar or Vermillion. It is prepared by mixing 40 of sulphur in an iron pot over a chauffer with 200 of metallic mercury & applying heat. When this is sublimed & reduced to powder a beautiful red colour is produced called vermillion.

Chloride of Do. or Calomel

It can easily be procured from the bichloride, the sulphate & the nitrate of mercury. From the nitrate it is procured by mixing a solution of the nitrate with common salt. From the bichloride it is procured by mixing it with metallic mercury & applying heat. Calomel was first introduced into medical practice by Paracelsus known to the world as a quack & empiric. He is the "Author" among Physicians. Calomel is used in medical practice to produce salivation & cure affections of the skin. The test of calomel is its producing a black precipitate with lime water & solution of Potassa.

Bichloride of Do

This is the corrosive sublimate of the Pharmacopoeia it is obtained by burning mercury in Chlorine gas or evaporating the solution of the muriate to dryness. It test is the hydriodate of Potass which produces a red precipitate which is the hydriodate of mercury. The corrosive sublimate is a deadly poison but Orfila says that albumen (the white of eggs) is a complete antidote.

Platinum

This valuable metal occurs only in the metallic State associated & combined with various other metals, such as Copper. Iron, Lead, Gold, Silver, Palladium, Rhodium, Osmium & Iridium. It has hitherto been found chiefly in Brazil, Peru & other parts of South America in the Ural mountains in Russia; in the form of Rounded or flattened grains of a metallic lustre & white colour, mixed with Sand & other alluvial deposites. Rich mines of Gold & Platinum have been for some time worked in the Uralian & into in Russia a platinum Coin is current. This is of a white Colour very much like Silver, but of an inferior lustre. Its density is the greatest known substance, its density being 21·5. It is inferior in malleability to gold & silver but for ductility it surpasses all the metals. Wires of Platinum have been made so fine as to be invisible except when red-hot. It has been drawn to the fineness of $\frac{1}{3000}$ of an inch. Platinum is not attacked by the pure acids, its true solvents being chlorine & Aqua-Regia. Ammonia also acts upon this metal. Platinum like iron can be welded.

Spongy Platinum

This can be prepared easily in the following manner. Unsized paper is moistened & dryed 3 times with a solution of the bichloride of Platinum the paper & ashes that are left contain the Platinum in a fit state for showing its action on hydrogen & other gases. When used for experiments with hydrogen & oxygen it is either made into small balls about the size of a pea with $\frac{1}{5}$ its weight in clay moistening the mixture & drying slowly. These balls should be exposed to a red heat in the flame of a Spirit lamp a short time before they are used in order to expel the adhering moisture. Platinum Platinum is not fused on exposing it to the strongest heat of a smith's forge, but small particles can be fused before the oxy-hydrogen blow-pipe.

Exp. 1. Take a small piece of thin platinum wire, coil it round the wick of a Spirit lamp, where the Spirit burns so as to make several turnings & then cut the flame after having allowed it

& burn for a short time. The heated Platinum determines the close combination of the Spirit with the air at an inferior temperature than the heat evolved in this manner is sufficient to maintain. the Platinum did not glow as there is any Spirit.

Platina

This compound may be obtained by decomposing the bichloride of Platinum with a solution of Potassa. It is a black colour.

Peroxide of Platinum

This salt is very difficult to form. It has however been procured by boiling the bichloride with sulphuric acid & decomposing the compound thus formed by means of Potassa.

Fulminating Platinum. Fulminating Platinum may be obtained by adding Ammonia to a solution of the sulphate, boiling the precipitate thats thrown down in a solution of Potassa. It must then be washed in a filter & allowed to dry. It explodes violently when heated to a temperature of 400°.

Chloride of Do

This is prepared by evaporating a solution of Platinum in nitro-muriatic acid to dryness heating the residuum with a small quantity of muriatic acid & heating it. Care must be taken not to heat it to redness.

Tests of Platinum. Hydriodic acid communicates a port-wine colour to salts of Platinum in solution

II Muriate of tin gives a bright red coloured precipitate.

III Potassa gives a yellow coloured precipitate.

IV Soda gives no precipitate.

V Sulphuretted hydrogen gives a black coloured precipitate which

VI when heated, yields metallic Platinum.

Silver

This metal frequently occurs native & also in combination with gold, antimony, copper, arsenic, & sulphur. Pure silver may be obtained for chemical purposes by placing a clean piece of copper in a solution of the nitrate of silver. Silver has the clearest white colour of all the metals & for receiving a polish is also surpassed by steel. In malleability & ductility it is inferior only to gold & platinum & its tenacity is considerable. Pure silver does not tarnish by exposure to air or moisture nor is it oxidized by fusion in open vessels. When in the form of leaves it is heated by means of electricity, galvanism or the oxy hydrogen blow pipe it burns with vivid scintillations & greenish white colour. The only pure acid that acts upon silver is the nitric ~~acid~~ forming with it nitrate of silver.

Oxide of Silver

The oxide of silver is best procured by pouring a solution of pure Baryta or lime water with a solution of nitrate of silver.

Fulminating Silver

When the oxide of silver recently precipitated by Baryta or lime water & separated from adhering moisture by bibulous paper is left in contact for 10 or 12 hours with a strong solution of ammonia, the greater part of it is dissolved & a black powder is procured called "fulminating silver." This was discovered by Berthollet & is so extremely explosive that it must be handled with extreme caution

Chloride of Silver

This is called "Luna cornua" or "horned silver." This is formed when silver is heated in chlorine gas or when the muriate of silver is evaporated to dryness. This compound when fused formed is of a white colour; but by the action of light ~~[illegible]~~ soon becomes purple. This is the most delicate test of silver

Sulphuret of Do.

It is formed when sulphuretted hydrogen is brought in contact with silver. This fact is well known to silversmiths, who cannot use coal gas in their premises; this is also the reason

that a silver spoon soon tarnishes when used with eggs.

Nitrate of Silver.

Is known as "Lunar caustic" of the surgeon. It stains by power & forms metallic silver into moulds.

Common marking ink. A hundred grains of lunar caustic must be dissolved in distilled water & 2 or 3 grains of gum arabic must be added. Before it is used however a preparatory liquid must be formed thus. Take 1/2 oz. of soda. dissolved in 2 oz. of water and add 1/2 oz. of gum arabic.

Tests of Silver. I. Is precipitated in a metallic form by Copper.

II. Muriatic, muriatic acid & common salt gives a white precipitate which alternately becomes purple.

III. Phosphate of soda gives a yellow precipitate.

Gold

This metal has been found in both the metallic state either pure or in combination with other metals. It appears in octahedral capillary or granular crystallized in cubes. Gold is the only metal which is of a yellow colour, a character by which it is distinguished from all other simple bodies. Its malleability exceeds all other metals. Its density is 19.3. Gold may be exposed for ages to air & moisture without change nor is it oxidized by being kept in a state of fusion in open vessels. When it is strongly ignited by means of electricity or the oxyhydrogen blow pipe it burns with a green blue flame & is deposited in the form of a purple powder supposed to be an oxide. When gold is alloyed with copper it may be separated by means of cupellation already described under Lead. Silver & Platinum cannot be removed in this manner as neither of these metals is oxidized by exposure to a high temperature. Platinum is not often alloyed with Gold & silver may be separated by the operation of quartation & parting. Quartation consists in fusing the alloy with 3 times its weight of silver, by which the particles of gold are separated to a greater distance from each other & prevented by covering the metals any of the particles of the silver from the action of nitric acid. Parting consists in boiling the alloy in 7 or 8 times its weight of nitric acid, by which the silver is dissolved & the gold remains pure in a porous state.

Protoxide of Do

This is prepared by decomposing the chloride of gold with a solution of Potassa. It is of a dark green colour, appearance of metal.

Chloride of Do

This substance is formed by dissolving gold in nitro-muriatic acid & evaporating. A neutral solution of chloride of gold is also formed by shaking gold leaf in chloride water.

Ammoniuret or Fulminating Gold

This is procured by adding Ammonia to a solution of the terchlo-ride of Gold as long as any precipitate appears. The yellow colour detonates loudly.

Ethereal Solution of Gold

This preparation is used for gilding a number of substances & may easily be made by shaking a strong solution of chloride of Gold with an equal bulk of pure ether, the ethereal solution collects above the heavier liquid remaining below.

Tests of Gold. I. Sulphate of iron precipitates Gold in a metallic form.

II. Protomuriate of tin produces a purple precipitate called the purple of Cassius.

III. When a drop of chloride of Gold is placed upon borax & the borax is exposed to the flame of a blow-pipe, a fine ruby colour or red coloured glass is produced. The finest colour on porcelain is produced by a salt of Gold.

Palladium

This metal was discovered in 1803 by Dr Wollaston. It is found along with Platinum & is separated from it by means of Cyanuret of Mercury. It resembles Platinum in colour & lustre, but is dissolved by nitric acid. Its salts are of a red colour & its specific gravity is 11.3.

Rhodium

This metal was discovered by Wollaston at the same time as Palladium. When the Palladium was separated from the Platinum, a Muriate of Iron precipitates the Rhodium. The Muriate of Rhodium is of a rose-red colour. Hence the name from the Greek. Rhodium is a black coloured powder, which requires the strongest heat which can be procured in a wind-furnace for fusion & when fused is of a white colour & metallic lustre.

Osmium

Osmium

This volatile & emits a peculiar pungent odour therefore it
name from osme odour. Nut galls give a purple precipitate
with solutions of Osmium, which is the test of the metal.
Oxide of Osmium is precipitated in a metallic state by
nearly all the metals excepting Gold & Platinum. On agita-
ting it with mercury an amalgam is formed which when hea-
ted in close vessels yields pure Osmium.

Irridium

This is the most infusible of all the metals, but by means of
the galvanic battery it has been fused into a globule of a bril-
liant metallic lustre & white colour. The solution of the
oxide of Iridium in muriatic acid when fresh prepared
is of a blue colour. Afterwards becomes olive green & then
of a deep red tint. On account of its change of colour it
obtains its name.

ALLOYS.

Brass

Brass is composed of copper & zinc usually in the proportion of 3 to 1 & occasionally contains a small quantity of other metals. A small quantity may be easily prepared by melting 2 parts of copper in a crucible, covering it with a little salt & charcoal to protect it from the action of the air & then putting in gently one part of zinc. Pour out the alloy as soon as the zinc has been completely melted & the metals have been stirred together with an iron rod.

Dutch metal & Pinchbeck

These are composed of the same metals & generally contain a large quantity of zinc, but various proportions are employed.

Bronze & Gun-metal

These are always composed of copper & tin. The proportions usually employed are about 8 or 9 parts of copper to one of tin.

Bell-metal

Bell metal is made of tin & copper in various proportions; 3 parts of copper & 1 of tin are frequently used

Speculum metal

The alloy used for making the Specular or, reflecting telescopes, is composed of 2 parts of copper & 1 of tin. A small quantity of zinc & arsenic about 1 part to each 30 of the alloy may be added & it is improved the result.

Alloy of Tin & Antimony

These metals combine readily when melted together & again the tin can be separated from the antimony when the proportion of the latter is small by boiling in Muriatic acid.

Pewter

The term "Pewter" is applied to a variety of alloys composed of tin combined with various proportions of other metals, Antimony, Zinc & Copper are the metals generally employed in the better kinds of pewter to which a small proportion of bismuth is frequently added. Inferior kinds of pewter contain about ½ of their weight in lead. Tin foil is a bad species of pewter containing tin & a half of lead (the latter simply to increase its weight).

Plumber's Solder

This alloy is composed of equal parts of tin & lead & for some species of work, one of tin to two of lead.

Printers' Types

Are composed of 3 of lead & 1 of Antimony.

The Fusible Alloy

The fusible Alloy (discovered by Sir. I. Newton) is prepared by melting in a crucible 8 of Bismuth 5 of lead & 3 of tin. It fuses at the temperature of 210°. Böte has pointed out a more fusible compound of the same metal. It consists of 2 of Bismuth. 1 of lead & 1 of Tin. This melts at a little about 200°.

Gold Coin

Gold coin is composed of 11 of Gold & 1 of Copper, or Gold is said to be 22 carats fine; Gold 24 carats fine is absolutely pure. (a carat weight 4 grains)

Standard Silver

Standard silver is an alloy of 12 parts & ½ & one of Copper.

Tin-plate

Iron is coated with tin by dipping it in a melted alloy composed of 10 of tin & 1 of Copper. The copper prevents too large a quantity of tin from adhering to the iron. The melted metal should be covered with a little tallow to prevent it from oxidizing. It is in this manner that tinned

iron is prepared, consisting of thin sheet iron coated with tin
Copper vessels are coated with tin by rubbing them over with mu-
riate of ammonia, throwing a little powdered resin on them
to prevent the copper from acquiring any rust. of oxide, & spread-
ing a little melted tin on their surface after exposing
them to heat.

Plating

Copper may be coated with silver after boiling in water with
cream of tartar & alum, by rubbing it with the following mix-
ture made into a paste with iron; 1 part of bichloride of
mercury, & of silver precipitated by a solution of the nitrate
of copper. 16 of chloride of sodium & 16 of the muriate of
Ammonia. The copper must be exposed to a red heat before
of the mercury, after which the coating of silver may be po-
lished.

Gilding

Steel may be gilded by dipping it into the ethereal solution
of the gold prepared in the manner formerly mentioned un-
der gold, dipping it into the liquid & washing it immediately
with water.

Amalgams

Mercury amalgamates readily with other a number of
other metals. Gold & silver are rendered very brittle by a
small quantity of mercury. 8 parts of mercury & 1 of
gold form an amalgam for gilding silver, copper. thus
The Amalgam is prepared by heating of the a mixture of the
above metals in the requisite proportions till the gold is
completely dissolved & pouring it immediately into cold
water to prevent the loss of mercury. The metal to be
gilded is previously washed with a dilute solution of the ni-
trate of mercury containing an excess of acid and the amal-
gam is spread as uniformly as possible over the surface
of the metal with a brush made of brass wire. By exposing
it to heat in a furnace the mercury is dissipated & the
gold is subsequently burnished.

Amalgam for electrical machines. 1 part of zinc, 1 of tin
& 2 of mercury form an excellent alloy for the purpose.

Amalgam for coating looking glasses. When mercury is pour upon tin foil, it spreads rapidly over the surface, form imperfect amalgam for this purpose.

Do for coating hollow globes of glass. This is composed of 1 of lead, 2 of bismuth & 4 of mercury. It will for silvering the inside of hollow globes of glass.

Fusible Amalgam. If 1 part of mercury be added to the fusible alloy, which we have formerly mentioned, the compound will become soft at 162° & fluid at 170°. Fusible teaspoons are made of this compound

Liquid Amalgam. 3 of mercury, 1 of lead & 1 of bismuth form an amalgam so fluid as to pass through chamois leather.

Organic Chemistry

Organic bodies are characterized;

I. By being composed of the same elements
II. By the facility with which they undergo spon-
taneous combustion decomposition.
III. By the impracticability of forming them by
the direct union of their elements
IV. By being decomposed at a red heat.

Organic chemistry is divided into Vegetable & Animal.

Vegetable Chemistry

Vegetable chemistry describes the properties of vege-
table bodies. The principles of bodies are either proxi-
mate or ultimate. The proximate principles
exist in the vegetables already formed & can be de-
tected by chemistry. The ultimate are the sim-
ple elements that result from the decomposition of the
proximate. Hence analysis is either proximate or
ultimate. —

In examining vegitable product, we will examine

1st. Vegitable acids. 2nd. Vegitable alkalies.
3rd. Resins, alcohol, ether. 4th. Sugar, Starch, Gum.
5th. Colouring matter. tannin, gluten, yeast, Vegitable (albumen
6th. Saccharine, viscous, acetic, & putrid fermentation, fer-
mentation
7th. Germination, growth, food of plants.

great care afterwards till the water is expelled. On the fused becomes a solid crystaline mass. By a high temperature it is completely decomposed. It is very soluble in water and deliquescent and must be kept in close vessels.

Acetate of Soda

This salt is prepared in large quantities by manufacturers of Pouligneous acid by neutralizing the impure acid with chalk and then decomposing the acetate of lime with sulphate of Soda. It crystallizes readily by evaporation and its crystals are not deliquescent when heated 550° it is deprived of its water and under goes the igneous fusion without parting with any of its acid. —

Acetate of Ammonia

Is made by neutralizing the common carbonate of Ammonia with acetic acid. It crystalizes with difficulty on account of its being highly soluble. It has long been used ~~as~~ in medicine as a Febrifuge, known by then ame of Spirit of Mindererus. —

Acetic Acid & Vinegar

This acid, exists already formed in the sap of plants is generated during the distructive distellation of vegitables and is an abundant product of the acetous fermentations. In this country common vinegar is procured from an infusion of malt or from sour porter or ale and in the continent from weak wines. The distilled vinegar which is now generally employed for the purposes of pypoligneous acid. Wood is put into iron vessels, and exposed to heat, charcoal remains, watery vapour. acetic acid, tar & pyroxilic spirit or pyroligneous æther pass over and are condensed in a receiver. The tarry matter is removed and lime added to the acid until it is neutralized. On exposing it to heat the pyroligneous æther is disengaged and may be collected in a receiver. To the solution of the acitate of lime, Sulphate of Soda is added, Sulphate of Lime falls down and acetate of Soda remains in solution. When if the acetate of Soda be dried & distilled with Sulphuric acid, the acetic acid is obtained in its purest state. Acetic acid is frequently contaminated with Sulphuric acid, lead or copper. Sulphuric acid is indicated by muriate baryta forming with it a white precipitate, lead is detected by hydriodate of potash and copper by ammonia.

Acetate of Potash

This substance is prepared by adding the purified acetic acid obtained from the distellation of wood to carbonate of Potasha in solution. Evaporating the solution with

Oxalic Acid

Oxalic acid occurs in the juice of sorrel - wood sorrel & many other plants in the state of oxalate of potash. It is always obtained by digesting sugar in nitric acid & may be procured with great ease; a lamp may be employed to commence the action, but must be removed until all the action ceases. Then evaporate to the consistence of a syrup & set it aside to crystallize. Two hundred parts of sugar yield 60 of oxalic acid. Many other substances, besides sugar yield oxalic acid when heated in the same manner as have wood, silk, linden, alcohol Gum-arabic. The composition of oxalic acid can be illustrated by heating it in a glass tube to which 6 times its weight of sulphuric acid. The whole passes off in 3 equal measures of carbonic acid & carbonic oxide. Oxalic acid crystallizes in 4 & 6 sided prisms, has an acid sour taste & reddens strongly the vegetable blues. In this manner it is distinguished from Epsom salts, for which it is frequently taken. Epsom salts have no effect on litmus paper, whereas oxalic acid renders litmus paper completely red. Magnesia & lime water are however complete antidotes to poisoning by lime. The most delicate test of oxalic acid is Lime-water. The oxalate of lime however is insoluble in nitric acid. Oxalic acid is used for taking out ink-stains & for cleaning the tops of boots.

Oxalate of Potash

Oxalic acid forms with potassa 3 compounds. 1. The neutral oxalate, which is formed by neutralizing the carbonate of potassa with oxalic acid. This must be

a suspend for time.

II. The Binoxalate. This is contained in sorrel & may be procured from that plant by evaporation solution & crystallization. It crystallizes readily in small four sided prisms which are less soluble in water than the neutral oxalate. It is often used in the name of "salt of lemons" for removing iron-moulds from linen, an effect which it produces by forming a soluble oxalate of iron.

III. This salt is of no practical value.

Oxalate of Ammonia

This is obtained by neutralizing Ammonia with acid it much used as a reagent in chemistry for the detection of lime.

Oxalate of Lime

The salts of all the insoluble oxalates is easily effected by the way of double decomposition. For a remarkable & a white, finely-divided powder is remarkable. For its extreme insolubility in water & on this account a soluble oxalate is a most delicate test of lime; but the oxalate of lime & insoluble in mineral & vegetable acids. This last circumstance is very important in a pathological point of view, because urinary concretions are not unfrequently composed of it. The chief source of what is called the mulberry calculus.

Oxalate of Magnesia

This salt is prepared by mixing the oxalate of Ammonia with a hot concentrated solution with the sulphate of magnesia. It is a white powder which is sparingly soluble in water, but more soluble when the sulphate of magnesia is employed. Oxalate of potassium is neutral

no precipitate - Hence the best means of separating lime from magnesia -

Tartaric Acid

This acid exists in the juice of several acidulous fruits, but is always in combination with potash - or lime. It is prepared by mixing intimately 1 part of powdered tartar with 30 parts of chalk - throwing the mixture by small portions at a time into 10 times its weight of boiling water. To each addition of the tartar effervescence ensues owing to the escape of the carbonic acid, one atom of the crystallizable bitartrate of lime subsides, while one atom of the neutral tartrate of potassa is held in solution. On cooling the former in water then digesting it, diffused through a moderate portion of water, the tartaric acid is set free. After being separated from the insoluble tartrate of lime by filtration it is obtained in crystals by evaporation. Tartaric acid has a sour taste, which is very agreeable when diluted with water. It reddens litmus paper strongly & dissolves 1 or 6 times its weight of water at 60° for solution & is more soluble in hot water. Alcohol dissolves it. When heated in close vessel, it sublimes & is decomposed yielding in addition to the usual products of distillation a peculiar distinct acid to which the name Pyro-tartaric has been applied - Tartaric acid is distinguished from other acids by forming a soluble precipitable with the bitartrate of potash) with an excess of potassa - And hence. Tartaric acid is an infallible test for potash, as potashes of tartaric acid - It forms also a white precipitate with lime, soluble in an excess of the acid thus distinguishing it from the oxalate & carbonates of lime -

Tartrate of Potassa

The neutral tartrate, frequently called "soluble tartar", is formed by neutralizing the bitartrate with carbonate of potash. It is a product of the operation above described for making Tartaric acid.

Bitartrate of Potassa

Of this salt are two species known called Tartar & Argal, is found encrusted on the bottom & sides of casks in which all the tartar of commerce is deposited. This salt, existing in the juice of the grape, & owing to its insolubility in alcohol is gradually deposited during the vinous fermentation. In its crude state it is coloured by the wine; but in its pure state it is quite white & is this state constitutes the Cream of tartar of commerce. It is very insoluble in water, but is used for a great many different purposes in commerce i.e. in the preparation of Black flux, white flux & all the tartrates.

Tartrate of Potassa & Soda

This salt, which has been long employed in medicine, is known by the name of Seldereignette or Rochelle salt, is formed by neutralizing the bitartrate of potash with carbonate of soda.

Tartrate of Soda

In forming effervescing draughts this salt is procured in a state of solution. When tartaric acid in solution is added to the bicarbonate of soda in solution, carbonic acid is evolved & tartrate of soda remains in solution

This salt is prepared by boiling equal weights of Cream of tartar & subcarbonate of soda in 4 times their weight of water, fil-

-tately the solution and evaporating the clear liquid till a pellicle appears on the surface. This salt is of a white colour its solubility in 3 times its weight of boiling water. Is used in medicine as an emetic -

Tests. I Add some nitric, sulphuric, or muriatic acid to a strong solution of tartar emetic, a precipitate immediately ensues of tartar is thrown down -

II. To a similar solution, add a small quantity of solution of potassa, soda or ammonia; the salt will combine with the tartaric acid & oxide of antimony is precipitated.

III Sulphuretted hydrogen gives a brownish yellow precipitate consisting of the sulphuret of antimony

IV. Throw some tartar emetic on hot coals or upon the flame of the blow-pipe or charcoal, & white fumes of antimony will appear -

Tartar-emetic, when administered in too large a portion acts as a virulent poison. The best antidotes are sulphuretted-hydrogen water, solutions of the hydro-sulphurets, infusions of cinchona, bark, galls, or tea -

Malic acid

This acid exists in most of the acidulous fruits, besides being usually frequently associated with the tartaric & citric acid - Grapes, currants, gooseberries & unripe apples contain it. Vauquelin found it in the Jamaica mixed with tartaric & citric acids in the house-leek (sempervivum tectorum). It is contained in a concentrated juice in a pellicle from which it is deposited in crystals. The malic acid may be formed by digesting 4 parts with 3 times its weight of nitric acid, but the best way of procuring it is from the berries of the mountain ash. The juice first deposits the colouring matter matter of the berries

carbonate of Potass. Citric acid is generally used as a substitute for lemon-juice & consequently taken as tea for a preventative of the scurvy. Citric acid also used for making effervescing draughts with Carbonate of Soda. When one part of citric acid is dissolved in 19 parts of water & few drops of the oil of lemon be added, a juice is formed which cannot be distinguished from lemon-juice.

hydrogen & charcoal is mixed with the acetate of lead as long as a precipitate endues. The malate of lead after being well washed in cold water, is dissolved by boiling water, from which it is separated deposited on cooling in delicate crystals of a brilliant lustre. It is then decomposed by a quantity of sulphuric acid, sufficient, in combining with all the lead, when a solution is procured which contains malic acid with a very little lead. The lead is subsequently removed by sulphuretted hydrogen & the malic acid is obtained in a state of purity. Pure malic acid has a very pleasant, acid taste; it crystallizes with great difficulty, it is apt to attract moisture from the atmosphere, is very soluble in water & alcohol, & the malates are soluble in boiling water & best distinguished from the citrates & tartrates

Citric Acid

This acid exists in most of the acidulous fruits, but exists plentifully in the lime & lemon. In any quantity of the juice of these fruits add finely-powdered chalk as long as any effervescence takes place & the insoluble citrate of lime after being well washed with water is decomposed by dilution & dilute sulphuric acid. The insoluble sulphate of lime is separated by filtration & the citric acid obtained in crystals by evaporation. It crystallizes in rhomboidal crystals terminated by plane surfaces. The crystals are large & transparent, undergo no change from the atmosphere, may be kept. If dry & long time without decomposition by heat a very sour taste, reddens litmus paper & when dissolved in water form a very agreeable draught. It is soluble in ½ its weight of cold & ½ its weight of boiling water. It may also be dissolved in alcohol. Citric acid may be distinguished from tartaric (to which it bears a resemblance) by forming a soluble salt with lime

Benzoic Acid

Benzoic acid is obtained from from benzoin which is sometimes the last - Indeed. this also found in the balsams of Peru & Tolu and some other vegetable substances. Mongeau first discovered it also in myrtle between the skin & kernel of the fruit. In the flower of the Tiliifolia. It is found in considerable quantities in the urine of cows & other herbivorous animals & perhaps may have been derived from the grass on which they feed. Benzoic has a sweet & aromatic taste than a sour taste, but it has likewise peculiar properties & when pure & free from hydrochloric acid at a temperature a little below its melting point, it sublimes & crystallizes without any change. It is not decomposed even by nitric acid. It undergoes the change by exposure to the air is very soluble in alcohol. It is easily decomposed by the nitric acid from the last that all the benzoids are decomposed by nitric acid principally acid followed by a deposition of benzoic acid.

gallic acid is obtained from nut-galls. Any quantity of these seeds to powder & infused for a few days in 4 times their weight of water & the infusion after being strained through linen & kept for two months in a partially warm atmosphere - A yellow crystalline matter is deposited, which is impure gallic acid. Gallic acid has a slight astringent taste. It decomposes ferrous & effervesces with the alkaline carbonates with lime-water, it produces a brownish-green precipitate with iron a black, forming the gallate of iron or ink. Instead of gallic acid, an infusion of galls is generally used to test for iron; which is made by pouring a few oz. of boiling water over nut-galls & leaving it to stand for some time before filtration. The tincture here refer to be prepared by digesting the powder of the gall nuts in alcohol. Nut-galls or gallic acid precipitate mercury yellow, dead white & copper green, gold brown, iron purple or black, gold brown, which readily possess to the metallic state. The sulphate of iron is decomposed by alkalis, the colour of ink is destroyed by the action of these bodies - In this manner ink is detected by acids. The iron - mould therefore is destroyed by lemon acid but after. It has been laid on the cloth, the iron acquires a degree of solution, which renders it insoluble in the acid, then it may be washed out by a solution of soap & water & the cloth will be sufficiently discharged to render it soluble.

N.B. Muriatic & lemon acid will be considered under Morphia & Lucia -

Opium

This body is composed of a very peculiar vegetable alkali called Morphia v. a vegetable acid called Meconic v. a resinous vegetable, which is neither acid nor alkali called Sarcocine

Morphia

To obtain Morphia, Opium must be bubbled in a mortar with water & allowed to remain about 2 days. by from following a brown liquid passed through which is the Meconiate of Morphia. Boil this solution with Magnesia the Meconiate of Magnesia is formed, Morphia being precipitated. Wash the precipitate with cold water. Dissolve the morphia in alcohol & boil it after filtration, when the solution cools, crystals of Morphia will be formed. Morphia is of a white colour crystallizes readily in small rectangular. Powder of a brilliant whole. Taste is disagreeable. Principle on which the narcotic property of Opium now immediately depends. Its taste is extremely bitter. From its sparing solubility in water, it has very little effect on animal economy. In this solution however, it acts on the animal frame so powerfully that half a grain may produce almost dangerous effects. This body converts the blue infusion of Cabbage into green. It therefore an alkali.

Sulphate Sulphated Hydriodate Nitrate &c

Morphia

There are prepared when a small quantity of Morphia is shaken with some of the respective acids. The mineral acids however must be in a state of dilution, for if they are strong they are apt to decompose the morphia which compounds of morphia are decomposed by dilution of water. Starch & Mucilage & the Morphia is deposited -

Meconic acid

This acid exists in opium in combination with morphia, forming Meconiate of Morphia. It can easily be formed by triturating opium in water & filtering. The Meconiate of morphia passes through. This has to be decomposed by acetate of lead, then the meconiate of lead subsides & the acetate of morphia remains in solution. Then by precipitate with water, & adding sulphuric acid the sulphate of lead subsides. The meconic acid is obtained in a state of purity. The test of meconic acid is a per salt of iron which produces a red precipitate easily distinguishable from every other body; for although the sulphocyanade of iron is of a red colour also, this last becomes white by the addition of hot water, whereas the meconiate of iron always retains its colour.

Narcotine

This is another principle found in opium. It possesses neither acid nor alkaline properties. It is of a white colour & soluble in cold sulphuric ether, whereas morphia is alone soluble in hot. To obtain Narcotine, morphia must be macerated in cold sulphuric ether. When the supernatant liquor is poured off & the sulphuric ether is permitted to evaporate spontaneously, crystals of narcotine fall to the bottom. To this principle is attributed the disagreeable effects of opium such as head-ache & nausea; whereas the soporific effects are attributed to morphia, consequently opium before it is made into Laudanum must be dipped in cold sulphuric acid as an antidote. Laudanum, Carbonate of potasta has been recommended in order to produce pure morphia, which does not act under in combination with acid, but no antidote can be relied on.

Quina, Cinchonia & Kinic acid

These are obtained from Peruvian bark: the two first are alkalies in combination with Kinic acid, as Kiniate of Quina or Cinchona. Cinchona was discovered by Duncan of Edinburgh at the beginning of this century, & ascertained the febrifuge qualities of the bark depended on the presence of these alkalies and consequently in intermitting fevers, Sulphate of Quina and other compounds of Quina or Cinchona.

Oils

Oils are characterized by a peculiar unctuous feel, by inflammability & insolubility in water. They are divided into the fixed & essential oils, the former of which are permanently fluid on the surface of water & leave a greasy stain. No portion which is permanent, while the latter owing to their volatility produce a stain which disappears or by a gentle heat.

1. Fixed Oils

The fixed oils are usually contained in the seeds of plants, as the almond, linseed, rape-seed, & poppy seed: but these oils are extracted from the fruits which surround the stone. They are procured by bruising the seed & subjecting the pulpy matter to pressure in hempen bags, a gentle heat being generally employed to render the oil more limpid. To obtain oil on a small scale, steep 10 or 12 almonds in hot water & bruise them on a wooden. Then remove the almond paste. In a few minutes, when a considerable quantity of a clear colourless oil is procured. In the common & express, negotiable oils are prepared in the same manner, machinery being employed to give the required pressure. Fixed oils, (the palm oil excepted) are fluid at common temperature, they are lighter than water - their specific gravity being .96 to .96 - They boil at 600 of Fahrenheit. When heated & exposed in close vessels they are decomposed & there have been employed for the formation of Coal gas. Carbureted hydrogen gas by passing it through red hot tubes. Fixed oil undergoes considerable change by exposure to the air. The rancidity which then takes place is occasioned by the mucilaginous substances which they contain, they becoming acid. From the operation of the same cause, they gradually loose their limpidity & some of them become dry as no longer useful unctuous to the touch or give a stain to paper - The property for which linseed oil is remarkable

may be communicated quickly by heating a close vessel. by heating it in a close vessel. The drying oils are used in paint also for forming what are called varnish. When drying thus absorb a considerable quantity of oxygen. when oil is exposed to a freezing mixture, part of it will soon congelidate as thinner part will remain above. The latter has been named Elaine & the fluid portion Elaine. Stearin (from στηρ. suet) is the chief ingredient of suet, butter, lard, &c. is the chief cause of their solidity, whereas oils contain a greater proportion of Elaine (from ελαιον. oil) & are consequently fluid. when the oil is exposed to a freezing mixture & filtered, the Stearine is obtained in a separate form. when the mixture is made under water, the Elaine is procured in a state of fluidity. This principle is peculiarly adapted for freezing the wheels of watches &c, as it does not become solid by exposure to the air nor become solid before 20° of Fahrenheit. Accidents have frequently happened in watches, from oil suddenly taking fire. This is caused by the heated oil attracting oxygen so much, that great heat is produced during the combination. This experiment may be performed thus; Soak some cotton in linseed oil & lay it aside. If combustion does not ensue, a very considerable heat in time would be evolved. Oil is soluble in alcohol, for castor oil may be dissolved in alcohol to any extent. If this mixture be poured into water the oil is again diffused, the alcohol uniting with the water. The oils of the great wheel of oil is in painting those oils are only used which are called drying. If some linseed oil

When oils are treated with alkalies, liniments & soaps are produced. Olive oil with soda forms soft soap, & olive oil with soda forms hard soap. It has been found that Elaine & Elaine the most unite directly with the alkali, and form Margaric acid & Oleic acids which form soaps by uniting with the alkali. Soap can be made on a small scale, for the material is apt to boil over. Iron

vessel will however do for the experiment. Soap is dissolved in alcohol; this is one of the solutions which is generally used to test the purity of water. Add some of the solution of soap in alcohol to a glass of water, in which a little of the sulphate or muriate of lime has been dissolved. The acid in combination with the lime will unite with the alkali of the soap, forming a salt which will remain in solution & oil, or rather the Margaric & Oleic acid, will unite with the lime, & an insoluble soap being produced will settle in water, which is deposited in the form of a white curdy precipitate; the Margarate & Oleate of lime.

Experiment. Put a few grains of phosphorus in a glass containing a little olive oil & when the cork is withdrawn the mixture gleams.

Essential or Volatile Oils.

Aromatic plants possess their fragrance to the presence of an essential or volatile oil, which may be obtained by distillation, water being placed in the still along with the plant & a fire kept burning. The oil passes from over into the receiver, & is collected at the surface or bottom of the water according to the density of the oil. Volatile oils burn in the open air with a clear white light. The products of the combustion are water & carbonic. Essential oils on account of their high price are frequently contaminated with fixed oils, which can however be detected. If is a drop of essential oil be placed on paper no stain is left; but if fixed oils be on the paper. Nitric & sulphuric acids act violently on essential oils, to perform which experiment mix one drachm of sulphuric acid with 4 of any of the nitric acids in a glass; let it be one extremity of a tube & pour the mixture upon 2 drachms of oil of turpentine under a chimney. The turpentine will be immediately inflamed & large quantity of gas evolved:

engaged. Volatile oils also dissolve sulphur in considerable quantities forming a brown coloured liquid called Balsam of sulphur. To show this experiment boil sulphur in oil of Turpentine. The ~~volatile~~ compound formed burns with great brilliancy. The most interesting of the essential oils are those of Turpentine, Caraway, Cloves, Peppermint, Nutmeg, Thyme, Lavender, Cinnamon, Lemon & Chamomile. Of these the most important is the first which is much employed in the preparation of Camphor for medical & chemical purposes. This process by distillation of common Turpentine & when purified by a second distillation is called essence or Spirit of Turpentine.

Camphor

This inflammable substance which in several respects is closely allied with the essential oils, ~~with~~ already formed in the branches, roots & trunk of the Laurus Camphora of Japan from which it is obtained by distillation. Camphor has a bitterish, aromatic, pungent taste accompanied by a sense of coolness. It is unctuous to the touch & brittle, but possesses a degree of toughness which renders it difficult to be reduced to powder except with the addition of alcohol. Camphor is insoluble in water. It may be dissolved in alcohol but is immediately thrown down by the addition of water. With nitric acid it is converted into camphoric acid.

Resines

Resins are the inspissated juice of plants. It consists either pure or in combination with an essential oil. They are either ~~odoriferous~~ solid at common temperatures, but the undrunes & unctuous. They are non-conductors of electricity & when rubbed they become negatively electric. They are generally yellow & semi-transparent. They are dissolved by alcohol, ether & the essential oils & when powdered into a

ter they are deprived. Melted with wax & oil, resins constitute ointments, & plaisters; combined with oil or alcahol they form different kinds of varnishes. Sealing-wax is composed of lac, Venice turpentine & common resin. The composition is rubbed coloured black by lamp black & red by cinabar or red-lead. Lamp-black. Of the different resins the most important are common resin, Copal, Lac, Sandarac, Mastic, Elemi & Dragon's blood.

Common Resin

Common resin is procured by heating turpentine which consists of oil of turpentine & resin, so as to expel the volatile oil. When turpentine is extracted from the wood of the pine by heat partial decomposition ensues; & a small quantity of dark substance consisting of resin, empyreumatic oil & acetic acid is the product. When it is boiled it forms pitch.

Amber

Is a hard, brittle, tasteless substance, sometimes semi-transparent, but generally semi-transparent & opaque & of a glassy surface. It is found of all colours, but generally yellow & clear. & frequently contains leaves or insects. Its specific gravity is 1.065. Its fracture is even, with a glossy. It is capable of a fine polish & can be rendered electric by friction. It is insoluble in water & alcahol, though the latter when highly electrified, extracts a reddish colour from it. It is soluble in sulphuric acid & pure alkalies. Amber is met with plentifully in regular mines in some parts of Prussia especially along the shores of the Baltic. The upper surface is composed of sand, under which is a stratum of lime sometimes wanting, but chiefly mouldered or changed into a bituminous substance. Under the wood is a stratum of aluminous mineral under which the amber is found. Stony sulphureous concretions usually are often discovered in the pits. Detached pieces are also found occasionally on the sea coast in several countries. It has been found in gravel beds near London. In the Royal

Cabinet of Berlin there is a mass of 18 lb supposed to be the largest ever found. The insects in amber are not European. The origin of amber is involved in an impenetrable obscurity, but it is evidently vegetable & has flowed from vegetables in the shape of a balsam.

Balsams

The Balsams are native compounds of resin & benzoic acid issue from incisions made in the trees which contain them in the same manner as turpentine from the fir. Some of them such as Storax & Benzoine are solids, while others as for instance the balsams of Tolu & Peru are viscid fluids.

Gum – Resins

The substances to which this name is applied are the concrete juices of certain plants & consist of resin, essential oil, gum & extractive vegetable matter. The two former principles are dissolved by alcohol, the latter by water. Their proper solvent is therefore proof-spirit. Under the class of Gum-resins are comprehended several valuable metal, such as aloes, ammoniacum, asafoetida, euphorbium, galbanum, gamboge, myrrh,

Caoutchouc

This substance is obtained from the milky juice of different plants in hot countries. The chief of these is the Jatropha Elastica. The juice is applied in successive coatings on a ball of clay, & when of sufficient thickness, the ball is emptied the juice shaken out. Acids separate resin alone from the thinner part of the juice & this by coagulating it. The juices of cold plants yield nearly 2/3 of its weight, that of hotter plants less. Its colour when fresh is yellowish white, but it grows darker by exposure to the air especially so smoke. The elasticity of this substance is its most remarkable property. When warmed as by immersion in hot water & stripe of it may be drawn out to be nearly 8 times their original length & will return to their original length nearly. It hardens by exposure to cold, exposed to the fire it softens, swells up, & burns with a bright flame.

In Caen it is used for Candles. Its solvents are Ether, volatile oils, & Petroleum &c. Nitrous ether dissolves it better than the sulph. -ric ether. Evaporation of this solution be spread on any extended surface, the ether will soon evaporate & a coating of caoutchouc will be left unaltered in its properties. Naptha & Petroleum also dissolve it & leave it unchanged by evaporation. In the manufacture of waterproof cloth, the caoutchouc is dissolved in the Petroleum & spread on the cloth. Turpentine dissolves it forming a viscid liquid used for varnishing air-balloons. Alkalis act upon it so as to take away its elasticity. When distilled it gives out Ammonia & Carburetted Hydrogen. It therefore consists of Carbon, Hydrogen, a little Nitrogen & perhaps a trace of Oxygen. Caoutchouc may be formed into various substances before undergoing the process of solution, If it may be cut into a uniform slip of a proper thickness & spirally round a glass or metal rod. so that the edges shall be in close contact. Let this tube, if boiled for some time, the edges will adhere so as to form a tube. Pieces of it may be readily joined by touching the edges with the solution in ether; but this is not absolutely necessary, for if they be merely softened by heat & pressed together they will adhere very firmly. If linseed oil be rendered very dry by digesting it on an oxide of lead & afterwards after-filtered by a small touch & any substance. & dried by the sun or in the smoke it will afford a delicate & considerable firmness, transparent, burning like caoutchouc & retaining elastic-

This substance which partakes of the nature of a fixed oil is an abundant vegetable production, entering into the composition of the pollen of flowers, covering the skin of the fruit & many other parts & in many instances forming a kind of varnish to leaves of plants. From their circumstance it was long supposed that wax is solely a vegetable pro-duction that the wax of the honey-comb is derived from flowers only. But it appears from the observation of Huber that it must likewise be regarded as an animal production. Common wax is always more or less coloured & has a particular odour which it may be deprived by exposure to air & moisture or more speedily by the action of chlorine. At ordinary temperatures it is solid & brittle. it can however be cut when it is called waxy. It burns with a clear white light & is hence excellently adapted for forming candles. Wax is insoluble in water & is only partly soluble in boiling alcohol & ether, by which it is deposited on cooling. It is attacked readily by the alkalies with which it forms a species of soap. It is soluble in hot water. It unites in every proportion with fixed & volatile oils, forming the compo-unguent, the ointment & the cerate of the Pharmaco-pheias.

Alcohol

Alcohol has not hitherto been procured by the direct combination of its elements which are 8 oxy + 12 carb + 3 Hydro. or 9 water + 14 Olefient gas. but it is al-ways procured by distillation from liquids which have undergone the vinous fermentation. The term fermentation

which dead Animal & vegetable matters undergo at ordinary temperatures in combination with water. When a solution of sugar is putrifies into this state an intoxicating liquor is produced such as beer Cyder, its properties being more or less modified by the mucilagenous matter & other substances which the liquor may contain. This is termed the 'vinous fermentation' & the product in all cases of this kind is a portion of alcohol, such as is obtained from the fermented juice of the grape. When the liquor becomes sour the acetic fermentation immediately takes place. as a quantity of acetic acid or vinegar is then formed. All animal or vegetable substances are subjected to a still further change from the spontaneous reaction of their elements, which is termed putrefactive fermentation, & in it a large quantity of offensive gas is disengaged.

To form Alcohol. Take 2 or 3 oz. of sugar. mix it with 4 times its weight of water in a glass retort & add a small quantity of Yeast. Expose the temperature of 70° or 80°. In a short time it becomes turbid. Carbonic acid gas is disengaged; but in a few days the frothy scum disappears & it again becomes clear. The process by distillation yields alcohol. We may mention that Yeast or ferment is the term applied to the flocci which seperate from all solutions undergoing the vinous fermentation in liquids similar from those by which it is produced: when dried at a gentle heat it retains its properties, but when digested in boiling water it loses them entirely. To obtain pure or absolute alcohol, hot carbonate of potass is put into it which seperates the water from it. Pure alcohol has the specific gravity of 0.796. at 0.822, it contains 90 of alcohol out of 100 * at 0.848, 80 - * at 0.872. 70 - * at 0.896, 60

·917. 50 of spirit or proof spirit which is half water & half spirit * ·939, 40. * ·958, 30. * ·974, 20 * ·988, 10. * ·992, 6. or any spirituous liquor of this gravity has only 6 gallons of spirit to 100 of water. Pure alcohol is a transparent colourless liquid having a fragrant odour and a hot pungent taste. It is extremely volatile but cannot be frozen.

Ether

<u>Sulphuric ether</u> is formed by distilling equal portions of sulphuric acid & alcohol, & applying a gentle heat & condensing in a cold receiver. In the formation of oil of wine gas a considerable quantity of ether is disengaged before the gas is formed. Water can only dissolve a small quantity of ether, but ether & alcohol combine in every proportion. When ether is subjected to destructive distillation, carbon, oxygen & hydrogen are the results. From its extreme volatility the evaporation of ether is frequently employed to form artificial cold. When a wire of platina is plunged into a jar filled with the fumes of ether, the platina will remain incandescent as long as any ether exists. When a bottle is filled the fumes of ether, if a light be applied they will inflame. Phosphorus is soluble in ether when this solution is poured upon sugar, which soon is immersed in hot water, a luminous appearance resembling the phosphorescence of the sea, is produced.

<u>Nitric ether</u> can be obtained by distilling nitric acid & alcohol, but such an effervescence is produced as to render the mixture unmanageable. The easiest plan is to mix equal weights of alcohol & strong nitric acid. In a few days ether appears on the surface, which

may be drawn off with a syphon. Nitric ether is of a pale
yellow lemon-yellow colour & is much more inflammable
than sulphuric ether.
N.B. In mixing nitric acid with alchahol, great care
must be taken. A small quantity of nitric acid may be
mixed with a greater quantity of alcahol with impunity.
but if the contrary proportions be used, the alcahol will
flash into vapour & throw out the acid. Muriatic
Acetic, Muriatic, & Hydriodic Ethers are formed in
a similar manner to Sulphuric Ether.

BITUMINOUS SUBSTANCES

Under this title are included several inflammable substances, which though of vegetable origin, are found in the earth or issue from its surface. They may be conveniently arranged under the two heads of Bituminous & fossil.

Bitumen

Bitumen comprehends naptha, petroleum, mineral tar, asphaltum, & retinasphaltum.

1. Naphtha

Naptha is a volatile limpid liquid of a strong peculiar odour & light yellow colour. Its specific gravity when highly rectified is 0.758. It is very inflammable & burns with a light white flame, accompanied with much smoke. It is insoluble in water, but very soluble in alcohol. It unites in every proportion with sulphuric ether, & petroleum & oils. Naptha contains no oxygen & is therefore useful for preserving the potassium & the more oxidizing metals from oxidation. It is also obtained by distillation from coal tar, & it is to this body that coal gas is indebted for its offensive smell. It is by rectified that Caoutchouc is dissolved before it is spread on the cloth for the manufacture of elastic cloths, articles. It occurs in considerable quantities on the shores of the Caspian sea. In Italy it is used instead of oil for lamps, being found in Calabria, Parma &c.

2. Petroleum

Petroleum is much less limpid than Naptha, has a reddish-brown colour & is unctuous to the touch. It is found in several parts of Britain as in Clattain,

Experiments

1. Dissolve sugar in Alcohol every Case. crystals will be deposited after Evaporation.

2. Put two pieces of sugar together in the Hand & squeeze, then separate & their ends appear.

3. Mix equal parts of sugar & chlorate of potash & drop of Sulphuric Acid will set the solution on fire.

4. Pour nitric Acid upon sugar & dried & the result. is wood, gum, starch, Linen Rags, & glue are converted into sugar by sulphuric Acid & even. Paper. Hence sugar may be obtained from almost every vegetable substance.

well, Edinburgh. This is also called mineral-oil. Mineral tar is very similar to Petroleum. but is more viscid & of a deeper colour. both of these fluids become thick when exposed to the atmosphere & pass into mineral-pitch, which formerly was called Bitumen.

Asphaltum

Asphaltum is a solid bitumen; hence called Mineral Muggy mineral pitch. It is of a black colour, extremely brittle & conchoidal fracture. It melts easily & very inflammable. It is found in East-Lothian, & Neufchatel. The latter is evidently derived from the Lacus Asphaltites, where it is found floating in a soft or liquid state. This substance was used by the Egyptians for embalming the dead, which process was performed in three different manners. 1st with Muggy mineral pitch 2 asphaltum alone. 3rd with a mixture of bitumen & liquor extracted from cedar or the cedrus. 3rd with a similar mixture to which odoriferous aromatic substances were added. The ancients also used asphaltum in mortar. The walls of Babylon are said to have been built with a cement of this kind. It is also said that Asphaltum was an ingredient of the famous Grecian fire, which burnt under water. At present this body is recommended for staining.

Resinous Phaltum

Bituminous phaltum is a peculiar resinous substance. It is found only in Bovey in Devonshire. It consists partly of Bitumen & partly of resin & possesses which last property it is indebted to the spirit it contains. All Bitumens are separated from the resinous principles of plants.

PIT-COAL.

Pit-coal is found in many countries, and is of various kinds. Some of it is very hard, and burns with a clear flame, while other kinds are soft, and burn with a smoky flame. Some kinds of pit-coal are very rich in bitumen, and others contain very little bitumen. Some kinds of pit-coal are very rich in carbon, and others contain very little carbon. Some kinds of pit-coal are very rich in ashes, and others contain very little ashes. Some kinds of pit-coal are very rich in sulphur, and others contain very little sulphur. Some kinds of pit-coal are very rich in iron, and others contain very little iron. Some kinds of pit-coal are very rich in lime, and others contain very little lime. Some kinds of pit-coal are very rich in magnesia, and others contain very little magnesia. Some kinds of pit-coal are very rich in alumina, and others contain very little alumina. Some kinds of pit-coal are very rich in silica, and others contain very little silica. Some kinds of pit-coal are very rich in potash, and others contain very little potash. Some kinds of pit-coal are very rich in soda, and others contain very little soda. Some kinds of pit-coal are very rich in lime, and others contain very little lime. Some kinds of pit-coal are very rich in magnesia, and others contain very little magnesia. Some kinds of pit-coal are very rich in alumina, and others contain very little alumina. Some kinds of pit-coal are very rich in silica, and others contain very little silica. Some kinds of pit-coal are very rich in potash, and others contain very little potash. Some kinds of pit-coal are very rich in soda, and others contain very little soda.

(a) Caking coal. This species is so named because when it is exposed to heat it softens & the particles adhere - &c. the coal found in Yorkshire are of this description - Those come from Newcastle. Staffordshire coal fulfils the same property -

(b) Splint Coal. This coal has a splintery fracture - & is found in considerable in the Lowlands of Scotland -

(c) Cherry Coal. This is the coal found in the neighbourhood of Glasgow. It burns easily, & is much used where easily to. - It burns the splint coal, which is much harder - It readily disperses fire, & burns with a clear yellow flame -

(d) Cannel Coal. This is found of peculiar purity & began to be worked - & used is known by the name of Parrot coal from the brilliancy of its light & is frequently used instead of candles whence its name - It has a very compact structure resembling jet. It does not soil the fingers & admits of high polish. Many trinkets are formed of it.

Comparison of Coal -

	Caking Coal.	Splint Coal	Cherry Coal	Cannel Coal
Carbon	78 · 28	75 · 00	74 · 45	64 · 72
Hydrogen	4 · 18	6 · 25	12 · 40	21 · 56
Nitrogen	13 · 06	6 · 25	10 · 22	13 · 72
Oxygen	4 · 58	12 · 50	2 · 93	0 · 0
	100	100	100	100

Sugar

There is an abundant vegetable product, existing in a great many fruits, though few often contain it in sufficient quantity to be profitably collected. Sugarcane, sweet flowers, some varieties of the American maple, &c do powerfully attract the bee, that it is applied to useful purposes - indeed it is the only sugar used by the Americans. Buckwheat was supposed in Sweden & Germany during the late war, from scarcity of cane sugar - but it extracted in small quantities in Spain &c. All the sugar used in this country is obtained from the sugar-cane - the juice exuding from the cane, the juice is procured by means of a mill, then slowly evaporating (cautiously boiling the juice to a consistency fitted for crystallization. During the operation lime-water is added - for the purpose of neutralizing the acid - when the syrup is sufficiently concentrated it is drawn off into shallow wooden coolers and there becomes a soft solid, composed of loose crystalline grains. These then put into barrels with holes through them, that the molasses or treacle may separate from the sugar - In this state it is imported into this country under the name of Muscovado sugar.

Lumps or Loaf-Sugar

This is obtained by boiling a solution of raw sugar with white of eggs & bullocks bloods adding lime-water - when sufficiently concentrated the clarified juice is received into shallow earthen moulds, the apex of which is undermost in order that the fluid which the sugar contains may be collected there & subsequently be drawn off by means of a plug - Hence the form of lump-sugar - In the process of refining it, it is important to concentrate the syrup at a low temperature, else the sugar loses its colour being burnt brown - Whence it is now customary to boil the syrup in vats from which the air has been expelled by an air-pump.